No. RW/BHP/MP/Canal(2)/2024-25
Government of India
Ministry of Road Transport & Highways
(Chief Engineer - Regional Office, Bhopal)
2nd Floor, Nirman Bhawan, Arera Hills, Bhopal-462011
PH: 0755-2551329, 0755-2571467, Email ID: ro.bpl-morth@gov.in

Date:05.06.2024

Invitation of Public Comments

Subject: Proposal for permission of Canal crossing by Narmada Valley Development Authority (NVDA) Bargi Diversion Projects on NH-943 & NH-39 in the state of Madhya Pradesh

CE(NH), MPPWD, Bhopal vide letter no. N.H/R/Canal Road crossing/NVDA/2024/276 dated 27.05.2024 forwarded therewith a proposal in this office for Permission for Canal crossing by Narmada Valley Development Authority (NVDA) Bargi Diversion Projects on NH-943 & NH-39 in the state of Madhya Pradesh.

2. As per Ministry vide OM No. RW/NH-33044/29/2015/S&R(R) dated 22.11.2016, the Highways Administrator will make available the proposal seeking permission for utility laying for public comments for 30 days on ground of public interest.

3. In view of the above the comments of public are invited on captioned proposal and the same should reach to below mentioned address within 30 days beyond which no comments will be considered.

The Highways Administration
O/o RO Highways Administration
Ministry of Road Transport & Highways
IInd Floor, Nirman Bhawan, Bhopal-462011.
Email: ro.bpl-morth@gov.in

4. This issues with the approval of Highways Administration-cum Regional Officer, MoRT&H, Bhopal. (Computer no. – 238179)

Signed by Shubham Kaushal Ahirwar
Date: 05-06-2024 17:43:07

Assistant Executive Engineer
For RO, MoRT&H, Bhopal

Copy to:

1. The Senior Technical Director, NIC, Transport Bhawan, New Delhi-110001 for uploading on Ministry's Website.
2. The CE (NH), MPPWD, Bhopal-for information.
3. The EE(NH), MPPWD Division Rewa-for information and requested to furnish the recommendation in view of Ministry's circular No. RW/NH-33044/29/2015/S&R (R) dated 22.11.2016 along with verified fees viz. license fee etc. as per circular and their detailed calculations

4. The Executive Engineer, Narmada Vikas Sambhag No. 07, Satna - for information with requested to submit the proposal in view of Ministry's circular no. RW/NH-33044/29/2015/S&R (R) dated 22.11.2016 and submit detailed calculation of license fee, restoration charges etc.

कार्यालय मुख्य अभियंता,
OFFICE OF THE CHIEF ENGINEER
राष्ट्रीय राजमार्ग परिक्षेत्र, लोक निर्माण विभाग
NATIONAL HIGHWAY ZONE M. P. PUBLIC WORK DEPARTMENT
"निर्माण भवन" प्लाट नं. 27–28 अरेरा हिल्स, भोपाल म.प्र.
NIRMAN BHAWAN 2nd FLOOR, BHOPAL M.P.
Email : cepwdnhzonemp@gmail.com , Phone/ Fax -0755 -2551570

Memo no. N.H/R/ Canal Road crossing/NVDA/2024/276 Bhopal, Date 27/05/2024

To,

The Chief Engineer-Regional officer
Ministry of Road Transport & Highway
Nirman Bhawan, Bhopal

OFFICE OF THE CE-REGIONAL OFFICER MORT & H NIRMAN BHAWAN BHOPAL No. 324 Date 27/05/24

Sub : Proposal for Permission of NH road Canal crossing by Narmada Valley Development Authority {NVDA} Bargi Diversion Projects [NH-943, NH-39]

Ref:- Executive Engineer, PWD NH Division Rewa memo no. 261/Tech/EE/2024-25 Dated 15.05.2024

Please refer to the memo cited under reference vide which Executive Engineer, PWD NH Division Rewa has submitted the following proposal for Permission of NH road Canal crossing by Narmada Valley Development Authority {NVDA} Bargi Diversion Projects [NH-943, NH-39] for necessary permission.

S. no.	NH no.	NH crossing at RD	Canal Name
1	943	81+400 M	Nagod Satna Branch Canal
2	39	8025 M	Mohari Distributary
3	39	7100 M	Umarhat Distributary
4	39	1310 M	Reruwa Kalan Minor
5	39	1575 M	Bamurahiya Minor

In view of above, it is requested that the necessary permission of 05 nos. location of Canal crossing may be granted for subjected work.

Encl: As above (Proposal in Original)

Approved by Chief Engineer (NHs) 27/5/2024

SUPERENTENDING ENGINEER
OFFICE OF THE CHIEF ENGINEER
NATIONAL HIGHWAY ZONE
M.P.P.W.D BHOPAL

Endt. no. N.H/R/ Canal Road crossing/NVDA/2024 Bhopal, Date /05/2024

Copy is forwarded to,

1. The Executive Engineer, PWD NH Division Rewa for information.
2. The Executive Engineer, Narmada Development Division no. 7, Bandhsagar Satna for information.

Sd/-

SUPERENTENDING ENGINEER
OFFICE OF THE CHIEF ENGINEER
NATIONAL HIGHWAY ZONE
M.P.P.W.D BHOPAL

कार्यालय कार्यपालन यंत्री,

लोक निर्माण विभाग राष्ट्रीय राजमार्ग संभाग रीवा (म.प्र.)

Email.Id:- eepwdnhrewa@mp.nic.in Phone NO.:- 07662-250274

पत्र क्र. 261 /तक./का.यं./2024-25 रीवा, दिनांक...15/05/2024

प्रति,

मुख्य अभियंता
लो0नि0वि0 रा0रा0 मार्ग परिक्षेत्र
निर्माण भवन भोपाल (म0प्र0)

विषयः- नागौद (सतना) शाखा नहर आर.डी. 55.600 से 83.00 अंतर्गत वितरण प्रणाली नहर से रोड क्रासिंग की अनुमति बावत्।

संदर्भः- कार्यपालन यंत्री नर्मदा विकास संभाग क्रमांक 7 सतना बाणसागर सतना म.प्र. का पत्र क्रमांक 719/कार्य/2024/सतना दिनांक 16.04.2024

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उपरोक्त विषयांकित संदर्भित पत्र के संबंध में निवेदन है कि रा0रा0 मार्ग क्र. 39 में आर.डी. 55.600 से 83.00 अंतर्गत नहर सिचाई वितरण प्रणाली से रोड क्रास कर नहर का निर्माण कराये जाने का ड्राइंग, डिजाइन एवं प्राक्कलन अनुमति हेतु प्रस्तुत किया गया है जिसका विवरण निम्नानुसार है :-

क्रमांक	NH No.	NH Chainage	नहर का नाम	NVDA आर डी.	लागत (रु. लाख में)
1	2	3	4	5	6
1.	943	56.80	नागौद (सतना) शाखा नहर	81400.00	1,53,23,359.00
2.	39	142.40	मौहारी डिस्ट्रिबूटरी	8025.00	18,10,525.00
3.	39	146.00	उमरहट डिस्ट्रिबूटरी	7100.00	35,07,060.00
4.	39	148.80	रेरूआ कला माइनर	1310.00	13,37,064.00
5.	39	140.00	बमुरिहा माइनर	1575.00	15,04,740.00

अतः उपरोक्त नहर शाखा मार्ग क्रासिंग कर निर्माण की अनुमति प्रदाय हेतु सादर संप्रेषित है।

संलग्नः- उपरोक्तानुसार।

कार्यपालन यंत्री
लोक निर्माण विभाग रा.रा. मार्ग
संभाग रीवा (म.प्र.)

पृ.क्र. /तक./का.यं./2024-25 रीवा, दिनांक.....

प्रतिलिपि:-

1. मुख्य अभियंता – क्षेत्रीय अधिकारी सड़क परिवहन एवं राजमार्ग मंत्रालय निर्माण भवन भोपाल (म.प्र.) की ओर सादर सूचनार्थ संप्रेषित।
2. कार्यपालन यंत्री नर्मदा विकास संभाग क्रमांक 7 सतना बाणसागर सतना म.प्र. की ओर सूचनार्थ।

संलग्नः- शून्य।

कार्यपालन यंत्री
लोक निर्माण विभाग रा.रा. मार्ग
संभाग रीवा (म.प्र.)

GOVERNMENT OF MADHYA PRADESH

NARMADA VALLEY DEVELOPMENT AUTHORITY

BARGI DIVERSON PROJECT

NAGOD SATNA BRANCH CANAL FROM RD 55.60KM TO 83.00 KM

N.H CROSSING AT RD - 81400 M

Prepared & Submitted By :

OFFSHORE INFRASTRUCTURES LIMITED

Design calculation for NH CROSSING at RD 81400 Mts

1.1 **Canal Datas:**

Sr.no.	DESCRIPTION	UNIT	PARTICULARS
1	Discharge of canal	CUMECS	49.202
2	Bed width U/S & D/S	m	4.80
3	Side Slope Inner		1.5 : 1
4	Outer		2 : 1
5	Full Supply Depth	m	3.8
6	Velocity	m/sec	1.251
7	Bed Slope		1 in 5500
8	Free Board	m	1.00
9	Mannings 'N'		0.018
10	C.B.L.	m	340.145
11	F.S.L.	m	343.945
12	T.B.L	m	344.945
13	Bank Left / Right	m	3.5 6.5
14	Nature of Canal		Lined

2 **Bridge Datas:**

2.1	Formation Level	m	345.795
2.2	Ground Level	m	345.12
2.3	Clear Span	m	7.00
2.4	Center to Center Span	m	8.20
2.5	No. of Spans	nos	3
2.6	Overall width of roadway	m	30.00
2.7	Angle of Skew	°	30°
2.8	No. of LANES		4 LANES

OFFSHORE INFRASTRUCTURES LTD.

Sub Engineer
N.D. Division No. 7
Satna (M.P.)

Assistant Engineer (F-23..)
N.D. Division No. 7
Satna (M.P.)

1.2 Calculation for enlarged Canal Section under Bridge

Formation level = 345.8 (adopted because of surrounding conditions of Ground level is higher than TBL)

Assumptions :-

Thickness of wearing Coat	=	0.075 m	7.4.13
Thickness of Slab	=	0.775 m	As per MOST Publication for solid slab
Thickness of Pier Cap	=	75 + 0.02 S mm	As per E_in_C Pub No.1 Clause 7.4.16
	=	215 mm	
	=	0.3 m	(Provided)
Top Width of Pier	=	1.20 m	As per E_in_C Pub No.1 Clause 7.4.15

Hence of level of Bottom of Slab	=	344.945 m
Level of top of pier	=	344.645 m
Height of Pier from F.S.L.	=	0.7 m
Height of pier from C.B.L.	=	4.50 m
width of pier at F.S.L.	=	1.20 m
width of pier at C.B.L.	=	1.20 m

Due to construction of piers the water way of the canal will be obstructed and the afflux will be created.

To avoid the afflux the bed width of the canal is increased keeping the side slopes same such that the water way at bridge site remains unchanged i.e. water way is not obstructed at bridge site.

Let enlarge the canal in bottom and provide the pier such that water way restructed by piers is available in rectangular section between piers.

Area obstructed by pier:-

$$= \frac{3.03 + 3.800}{2} \times 1.2 \times 2.00$$

$$= 4.10 \times 2.00$$

$$= 8.196 \ m^2$$

Total obstructed area

$$= 8.196$$

$$= 8.196 \ m^2$$

water way (Original) of canal.

$$= (4.8 + 1.50 \times 3.8) \times 3.8$$

$$= 10.5 \times 3.8$$

$$= 39.9 \ m^2$$

water way reqd. so that the obstuction is not created

$$= 39.9 + 8.196$$

$$= 48.096 \ m^2 \ \ldots\ldots\ldots\ldots\ldots\ldots A$$

Let B = Width of canal required so that the water way is not obstructed.

the enlarged water way

$= B \times 3.8 + 2 \times \frac{1}{2} \times 3.8 \times (3.8 \times 1.5)$

$= B \times 3.8 + 21.66$ .....B

Equating A & B,

$B \times 3.8 + 21.66 = 48.096$

$B = \frac{26.436}{3.8} = 6.95684$ M

Say 7 m

Keep Enlarged Bedwidth of canal 7 m

By Keeping enlarged bedwith of canal 7 m

water way (Enlarged) of canal.

$= (7.00 + 1.5 \times 3.8) \times 3.8$

$= 12.7 \times 3.8$

$= 48.26\ m^2$

1.3 <u>Fixing the span:-</u>

vertical clearance = Bottom level of slab - F.S.L.

= 344.945 - 343.945

= 1 m = 1 m Ref. para 7.4.6

Level difference between Bottom of Slab and C.B.L.

= 344.945 - 340.145

= 4.8 m

Inner slope of Canal = 1.5 : 1

Width of canal Opening at R.L. 344.945

= 7.00 + 2.0 (1.5 x 4.80)

= 7.00 + 14.4

= 21.40 m.

Providing 3 No.s Spans with clear span of 7.00 m and top width of pier as 1.20 m

2 nos of pier . & 2 PIER Distance between outer faces -

= 3 X 7.00 + 2 X 1.20

= 21.00 + 2.4

= 23.40 m

Distance of burried abutment from the Canal slope line

$$= \frac{23.4 - 21.4}{2} = 1.00 \text{ m}$$

Hence Wing wall is provided at both ends of abutments.

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Assistant Engineer (F-.23.)
N.D. Division No. 7
Satna (M.P.)

1.4 **Scour Depth Calculation**

(in this case howver the canal is lined scour depth needbe caculated. However calculations are given as below:-

$$d = 0.473 \left[\frac{Q}{f}\right]^{1/3}$$

when d = Normal depth of scour in metres below the H.F.L

Q = discharge in cumecs = 49.202

f = Laceys silt factor = 4.75 for GRAVEL

$$d = 0.473 \left[\frac{49.202}{4.75}\right]^{1/3}$$

$$= 0.473 \times 3.45277$$

$$= 1.63316 \text{ m}$$

Max Depth of Scour = 2 x normal depth of scour

= 2 x 1.63316

= 3.26632

in the present case, FSD = 3.80 m

Hence maximum depth of scour is upto = 3.26632 - 3.80 i.e -0.5337

Hence maximum depth of scour is upto = 390.21 - 3.27 i.e 386.944

m below canal bed. The foundation is provided 2 m below C.B.L.

Hence Safe

1.5 **Design of deck slab:-**

The design of slab is not done. Its detail are adopted from the MOST publication Standard Plans for High way bridges Vol. II, plate SD/1 175 for Clear span 8 meter as following are the details in the present case:-

1 clear span = 7000 mm

2 Thikness of expansion joints. = 20 mm

3 overall depth of slab = 775 mm

4 Diameter of the bars and spacing will be same but the nos. and length of bars will get changed .

1.7 **Design of pier :**

As per para 7.4.15 of 7.4.13- E-in-C-70/1 the top width of pier shall be as

1.00 m clear span of 6m.

1.20 m clear span of 12 m.

in this case, the clear span is = 7 m. Hence the width of pier at top cap is provided 1.20 m and widened as 1.300 mts below 3.00 mt from pier cap.

Hence bearing length of slab at each end of the pier will be

$$= \frac{1}{2} (120 - 2) = \frac{118}{2} = 59 \text{ cm}$$

Depth of pier cap = 75 + 0.02 x 7000 ref para 7.4.16 of 7.4.13- E-in-C-70/1

= 215 mm Say 30 cm

Provide 30cm thik pier cap

Length of bearing = 150 + 0.04 x 7000

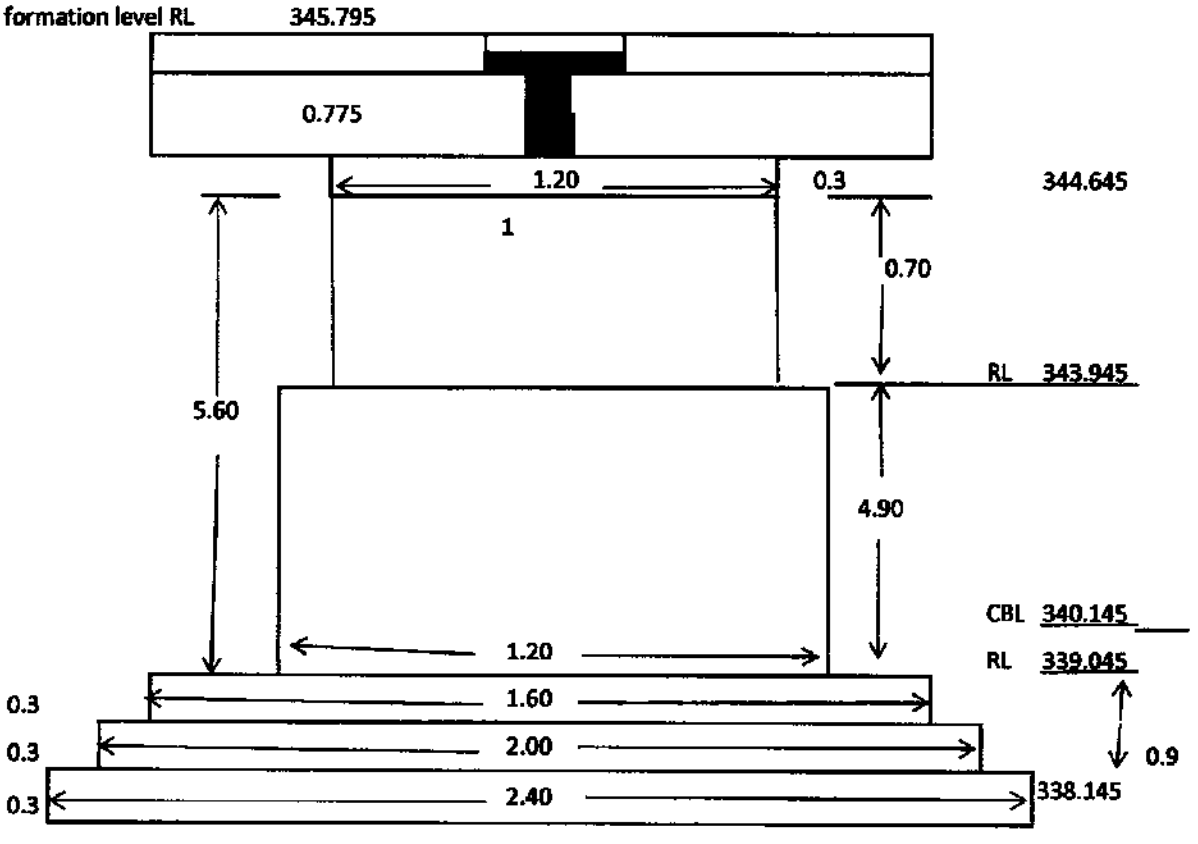
= 430 mm

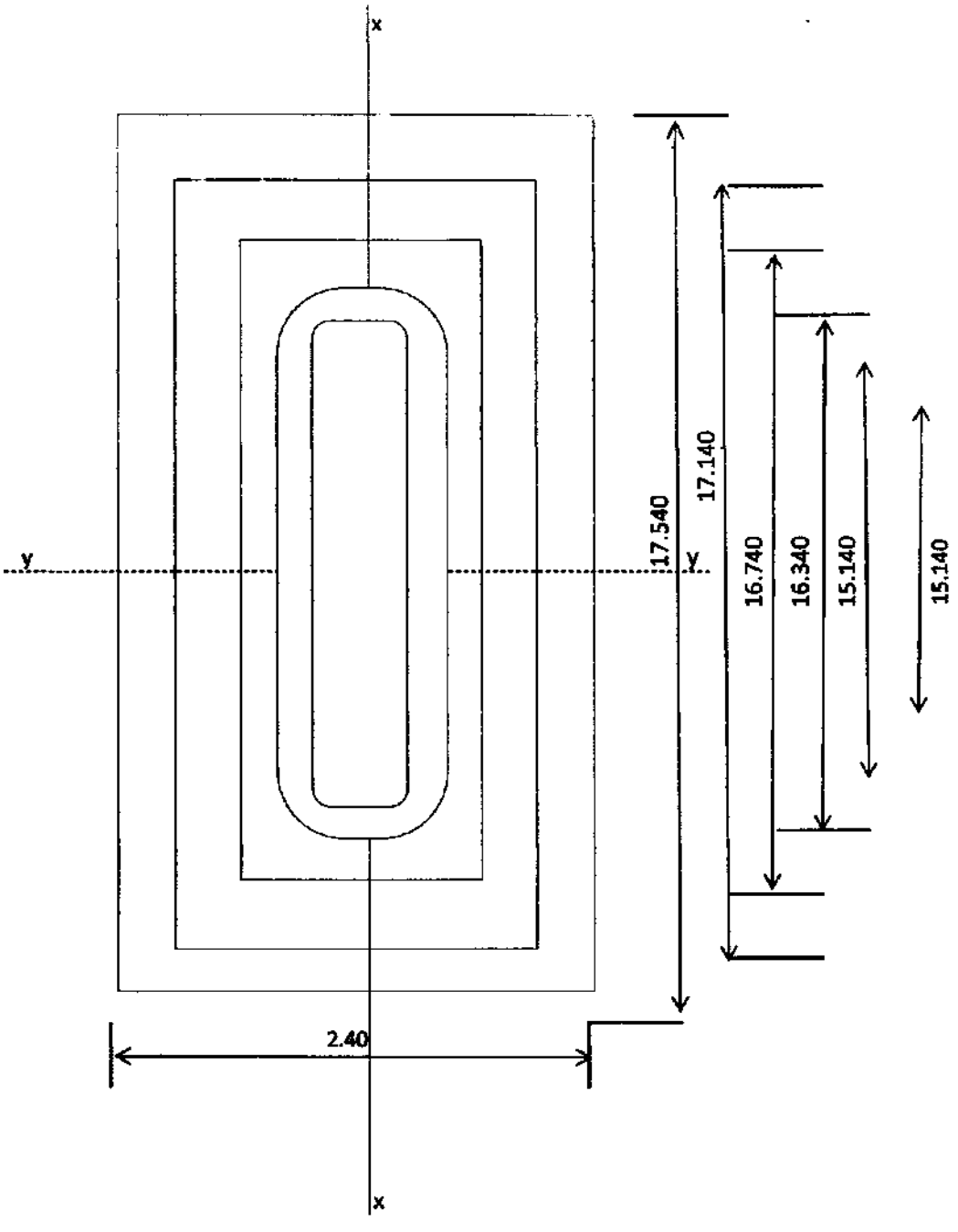
= 43 cm

but the length of bearing provided is

59 cm > 43 cm

Note: for design purpose max bearing length adopted. is 36 cm, wide 7.4.16 E-in-C-70/17.4.16





1.7.1 Dead Load of Supper Structure

Dead load given in MOST DRG no. BD/2-74 for 7.0 m Clear Span is 96.12 t. It is for 12 m over all width of Slab and 7+ 0.74 = 7.74 m c/c span. In present case the over all width of slab is 12.50 m. And c/c span = 8.18 m.

Hence in this case reaction of dead load

$$= 96.12 \times \frac{8.18}{7.74} = 101.58 \text{ t}$$

1.7.2 **Live load**

The carriage way will carry one lane of class A Vehicle

Impact factor for class A Loading = 4.5 / (6+ 7.40)

= 0.336

Effect of Single lane Class A Loading:-

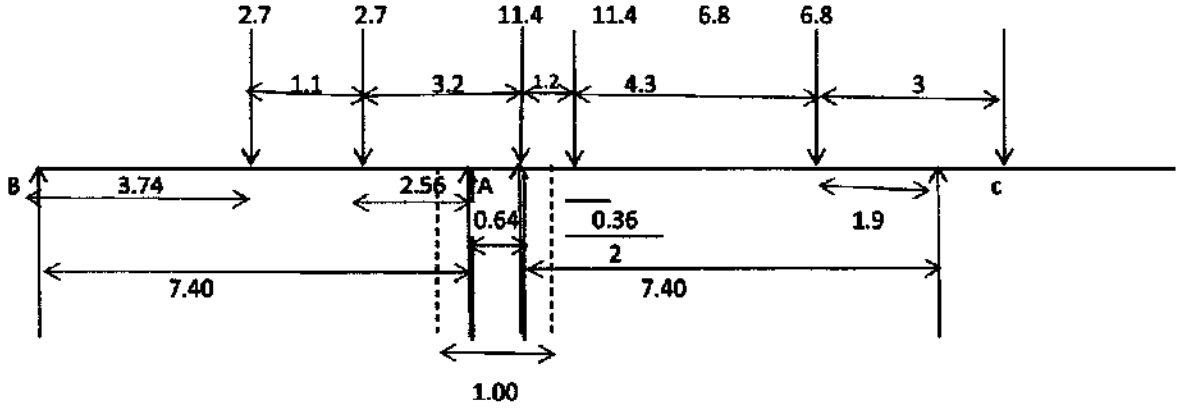
As shown below Class A Train of Wheel load is moving along the Span of the bridge Refer Sketch below. Two span of the bridge are loaded As per Sketch shown below the reaction at the Central pier will be due to loads on both the span.

if RL = Reaction form left span

if RR = Reaction form Right span

total reaction at Central pier = RL + RR

The maximum reaction on the pier will be obtained by placing the 2nd axis load at A. (Bearing of 36 cm only is Considered for design purpose)



all load are ton and distance in meter

Reaction from Right Hand Span

taking moment about point C.

$$RR \times 7.4 = 11.4 \times 7.4 + 11.4 \times 6.2 + 6.8 \times 1.9$$

$$= 84.36 + 70.68 + 12.92$$

$$RR \times 7.4 = 167.96$$

$$RR = \frac{167.96}{7.4}$$

$$RR = 22.6973 \text{ t}$$

Reaction from Left Hand Span

taking moment about point B.

$$RL \times 7.4 = 2.7 \times 3.74 + 2.7 \times 4.84$$

$$= 10.098 + 13.068$$

$$RL \times 7.4 = 23.166$$

$$RL = \frac{23.166}{7.4}$$

RL = 3.13 t

= RL + RR

= 3.13 + 22.6973

S.F. = 25.83 t

Note:- If the whole train is shifted by 0.64 m i.e. 11.4 t axle load is placed at RL , then

RL = 14.0635

$$RR = \frac{11.4 \times 5.56 + 6.8 \times 1.26}{7.40}$$

= 9.72324

Total reaction= 23.787 tonne

S.F. with two lane of class A loading will be = 51.66 tonne

S.F. at A with Impact load = 1.336 X 51.66

= 69.01 tonne

The maximum shear force with impact will be adopted .

Max S.F. = 69.01 tonne

1.7.3 **Longitudnal eccentricity of live load** (i.e. along the road bridge length) maximum eccentric load will be there, when the train of IRC claas A vehicle is plased as considered above.

reaction causing eccenticity will be

= 1.336 x (22.6973 - 3.13)

= 26.140

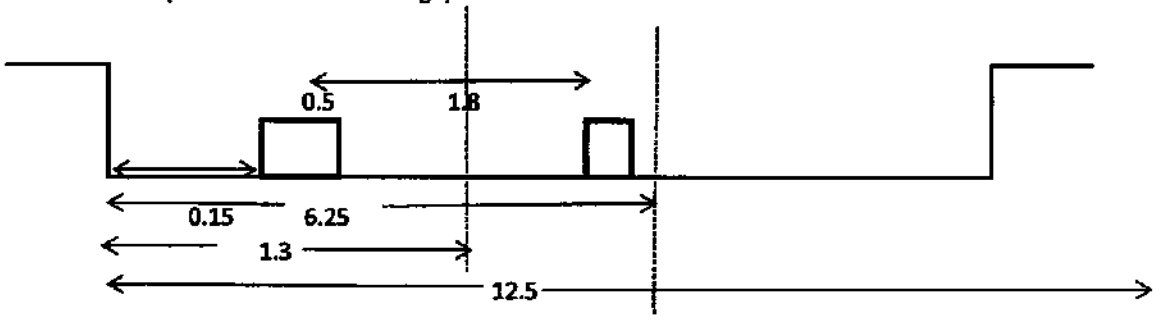
$$\text{Eccentricity} = \frac{1}{2} - \frac{0.36}{2} = 0.32 \text{ m}$$

Longitudinal eccenrtic moment = 26.140 x 0.32

= 8.365 t-m

1.7.4 **Transverse eccentricity of live load:**

(i.e. across the road bridge) sketch 1.7.4



for I.R.C. Class A vehicle loading will move as above (refer IRC 6-1966 cl 207.1) to give the maximum transverse eccentricity.

Distance of C.G. of live load from the kerb

= 0.15 + 0.5 + 0.65

= 1.30 m

eccentricity of loads from centre of pier

= 6.25 - 1.30 = 4.95 m

maximum live load reaction with impact

= 69.01 t (ref para 1.7.2)

moment due to eccentricity

maximum L.L. reaction with imapct x 4.95 m

= 69.01 x 4.95

= 341.600 t-m

1.8 Braking force: (Refer 214 .2 of IRC 6:1966)

it is equal to 20% of load present on the bridge.

Breaking force = 0.2 X 70 Impact is not to be considered.

= 14.00 t

the braking force shall act 1.2 m above the road way.

point of application from junction level

= Bearing level - junction level

= 344.95 - 339.05 = 5.9 m

moment = 14 x 5.9

= 82.6 t-m

1.9 Wind forces:

Since intencity of wind pressure depends on the height of the point above mean retarding surface, two cases for calculation of forces have been cansidered.

1 = When the water in canal is at FSL

2 = When the canal is empty

case 1 - when the water in canal is at FSL

(a) **wind force on the live load:** (ref. IRC 6-1966 cl. 212.4)

The wind force shall be considerd as acting 1.5 m above the road way and its value shall taken as 300 kg/linear m.

wind load per span = 8.2 x 300

= 2460

= 2.5 t

point of application from junction level

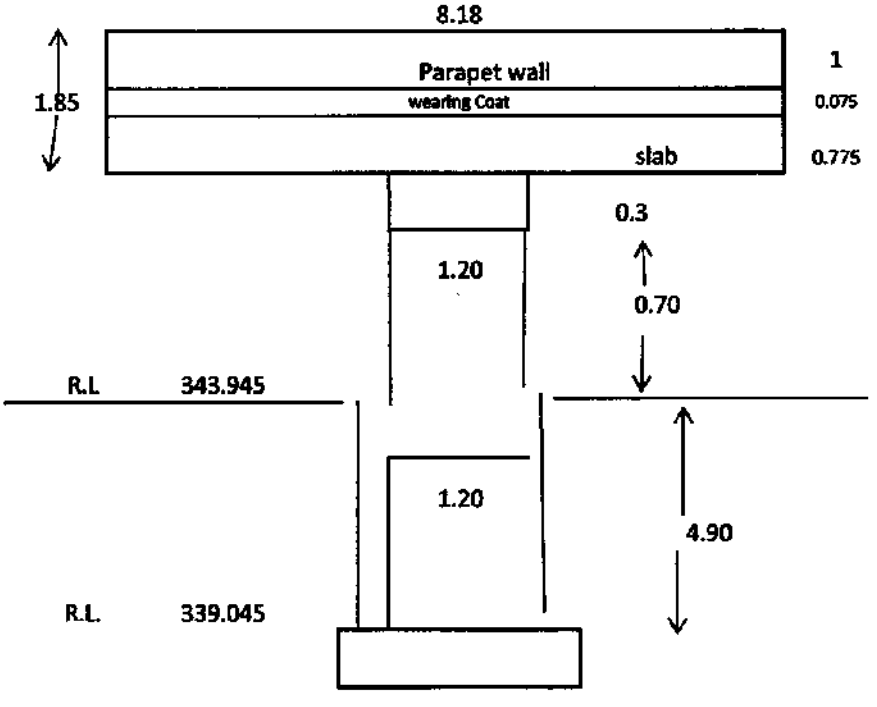
= 1.5 + formation level - junction level

= 1.5 + 345.8 - 339.045 = 8.25 m

moment = 2.46 x 8.25

= 20.295 tm

(b) wind forces due to sub & super structure (Ref. Sketch 1.9)



	Item	Area	Distance of CG. Form F.S.L	A X Y
	Slab + wearing coat + Parapet	8.18 x 1.85 = 15.133	0.70 + 0.3 + 1.85/2 = 1.925	29.131
	Pier Cap	1.2 x 0.3 = 0.36	0.70 + 0.3/2 = 0.85	0.306
	Pier above junction	1.20 x 0.70 = 0.84	0.7/2 = 0.35	0.294
		sum of A 16.333	Sum of AxY	29.73

Distance of C.G. from $= \frac{\Sigma AY}{\Sigma A} = 1.82$ m

for 1.95 M height above mean retarding surface the horizontel wind pressure =

(ref. IRC-6-1966 Clause 212.3)

$$= 40 + \frac{52 - 40}{2} \times 1.82$$

$= 40 + 10.92$

$= 50.92$ kg/m^2

wind pressure for 8.18 m length

$= 50.92 \times 16.333$

$= 831.676$ Kg/ m^2

wind pressure per running meter.

$$= \frac{831.676}{8.18} = 101.67 \text{ kg/m} < 150 \text{ kg/m}$$

As per IRC 6-1966 Clause 212.3 the minimum wind force should b taken as 450kg. Per running meter i/c live load. Hence 150kg/m force instead of 129.27 kg/m

wind force $= 150 \times 8.18$

$= 1227$ kg

$= 1.227$ t

acting at 1.82 m above FSL of canal point or application above junction level

$= 1.82 + 4.9$

$= 6.72$ m

Moment $= 1.227 \times 6.72$

$= 8.24544$ t-m

Case II **<u>when canal is empty</u>**

a. wind force on live load same as in Case I

b. wind force due to sub and super structure :

Item	Area	Distance of CG. Form F.S.L	A X Y
Slab + wearing coat + Parapet	8.18 x 1.85 = 15.133	5.60 + 0.3 + 1.85/2 = 6.825	103.283
Pire Cap	1.2 x 0.3 = 0.36	5.6 + 0.3/2 = 5.75	2.070

Pire above junction	1.20 x 0.7 = 0.84		4.90 + 0.70/2 = 5.25	4.410
pier upto jucntion	1.20 x 3.80 = 2.28		3.80 x 1 / 2 = 1.9	4.3320
	sum of A	18.61	Sum of AxY	114.09

Height of C.G. above CBL $= \frac{114.09}{18.61} =$ 6.13 m

intencity of wind pressure for 7.09m height

$$= 63 + 73 - 73 \times \frac{6.13}{2}$$

$= 63$ kg/m² (IRC 6 para 212.3)

wind force for one span $= 63 \times 18.61$

$= 1172.6$ kg

wind force per meter length $= \frac{1172.619}{8.18} = 143.352$ kg > 150 kg

Hence adopt 165.12kg/m run

wind force = 8.18 x 150

= 1227 kg

= 1.23 t

acting 6.13 m above CBL

point of application above junction level

= 6.13

= 6.13 m

Moment = 1.23 x 6.13

= 7.5399 tm

1.10 **forces due to current of water:**

case- I **<u>when canal is full</u>**

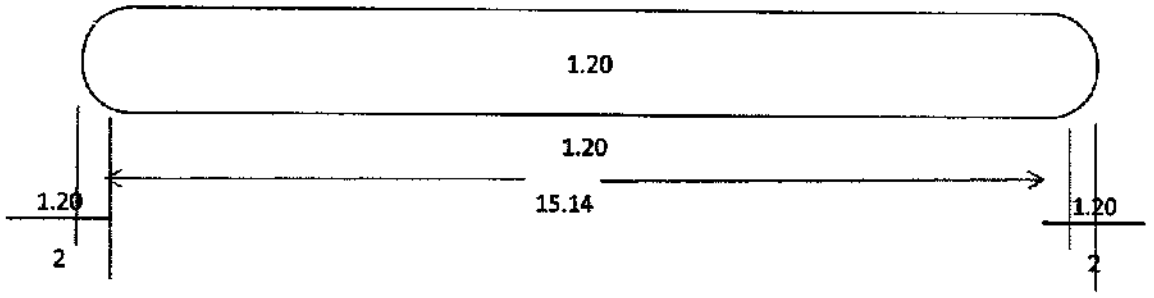
the value of v^2 in the equation $P=52\ Kv^2$ is assumed to vary linearly from zero at the point of deepest scour to the aquare of th maxmum velocity at the free surface. In present case the canal is lined and max velocity is taken as $2^{(1/2)}$

times the mean velocity. Maximum velocity $= 2^{1/2}$

times the maximum mean velocity of current

Maximum velocity = 1.414 x 1.251

= 1.7689 m/sec



a. force parallel to the length of pier.

the area on which current pressure will act

$$= \frac{1.20 + 1.2}{2} \times 3.8 = 4.56 \text{ m}^2$$

intensity of water pressure is given by $P = 52 KV^2$ $K = 0.66$

$= 52 \times 0.66 \times 1.76891^2$

$= 107.389 \text{ kg/m}^2$

force on pier = 4.56 x 107.39

= 489.695 kg

= 0.48969 tonne

Point of application from junction level

$$= \frac{3.8}{3} = 1.27 \text{ m}$$

moment parallel to length of pier

= 0.48969 x 1.27

= 0.62191 t-m

b. force perpendicular to length of pier

maximum variaton in the flow direction of water 20° Ref. IRC 6-1966 Cl 213.5

maximum velocity = V Sin 20

= 1.7689 x 0.342

= 0.605 m/sec

Area on which water Pr. Will act.

$$= \frac{16.34 + 16.34}{2} \times 3.8$$

$= 62.092 \ m^2$

intensity of Pr. $P = 52 \ KV^2$

$K = 1.5$ for square section

$P = 52 \times 1.5 \times 0.60497^2$

$= 28.547 \ kg/m^2$

Force = P x A

= 28.547 X 62.092

= 1772.54 kg

= 1.77254 tonne

point of Application from junction level

$$= \frac{3.8}{3}$$

= 1.267 m

moment perpendicular to the length of pier

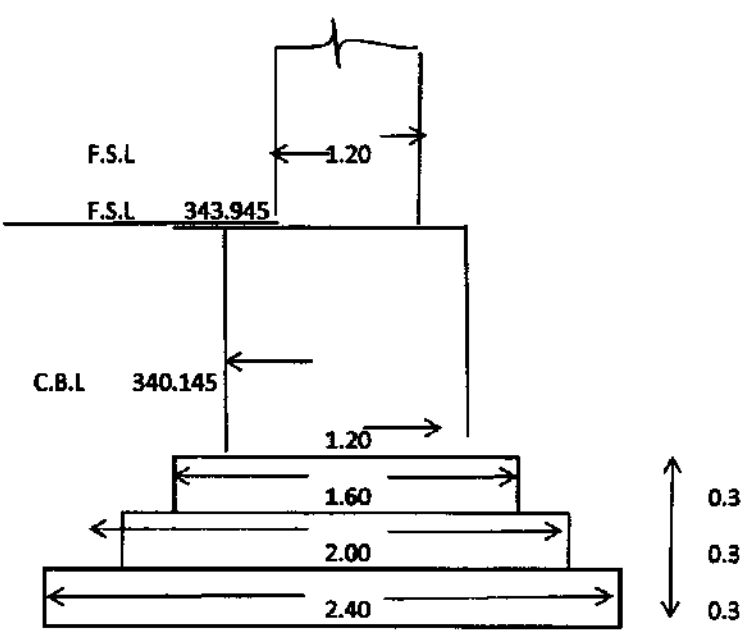
= 1.77254 x 1.267

= 2.24581 t-m

Case II when Canal is empty cross current is nil.

1.11 VERTICAL LOADS AT JUNCTION OF PIER & FOOTING

1.11.1 DEAD LOAD OF WATER AT JUNCTION LEVEL



Cross Section Area at junction level

$= 15.14 \times 1.20 + 0.785 \times 1.20^2$

$= 18.168 + 1.1304$

$= 19.2984\ m^2$

Cross Section Area at CBL

$= 15.14 \times 1.2 + 0.785 \times 1.2^2$

$= 18.168 + 1.1304$

$= 19.2984\ m^2$

Cross Section Area at FSL

$= 15.14 \times 1.20 + 0.785 \times 1.20^2$

$= 18.168 + 1.1304$

$= 19.2984$

value of water over pier upto junction level is nil as pier is straight.

Dead Weight of water $= 0$ t

1.11.2 **BUOYANCY AT JUNCTION LEVEL**

C.S. of pier at C.B.L.	=	19.30 m^2
C.S. of pier at F.S.L.	=	19.30 m^2
C.S. of pier at Jucnction level	=	19.30 m^2

Volume of pier section between F.S.L & canal bed level

$$= \frac{19.30 + 19.30}{2} \times 3.8$$

$= 73.33\ m^3$

Total volume of water displaced by pier upto junction level

$= 73.33$

$= 73.33\ m^3$

upward force due to bouyancy at junction level

$= 73.33$ t As per IRC 6-1966 Cl. 216.5

taking pore pressure as 15% of the full bouyancy on section of pier hence upward force due to bouyancy

$= 0.15 \times 73.33$

$= 10.9995$ t say 11 t

1.11.3 Dead weight of pier & pier Cap

a. Pier C.S. area at top = 1.20 x 15.14 + 0.785 x 1.20 ^{2}

= 18.168 + 1.1304

= 19.298 m^2

C.S. area at junction level = 19.30 m^2

Average C.S. area = $\frac{19.2984 + 19.30}{2}$ = 19.2984 m2

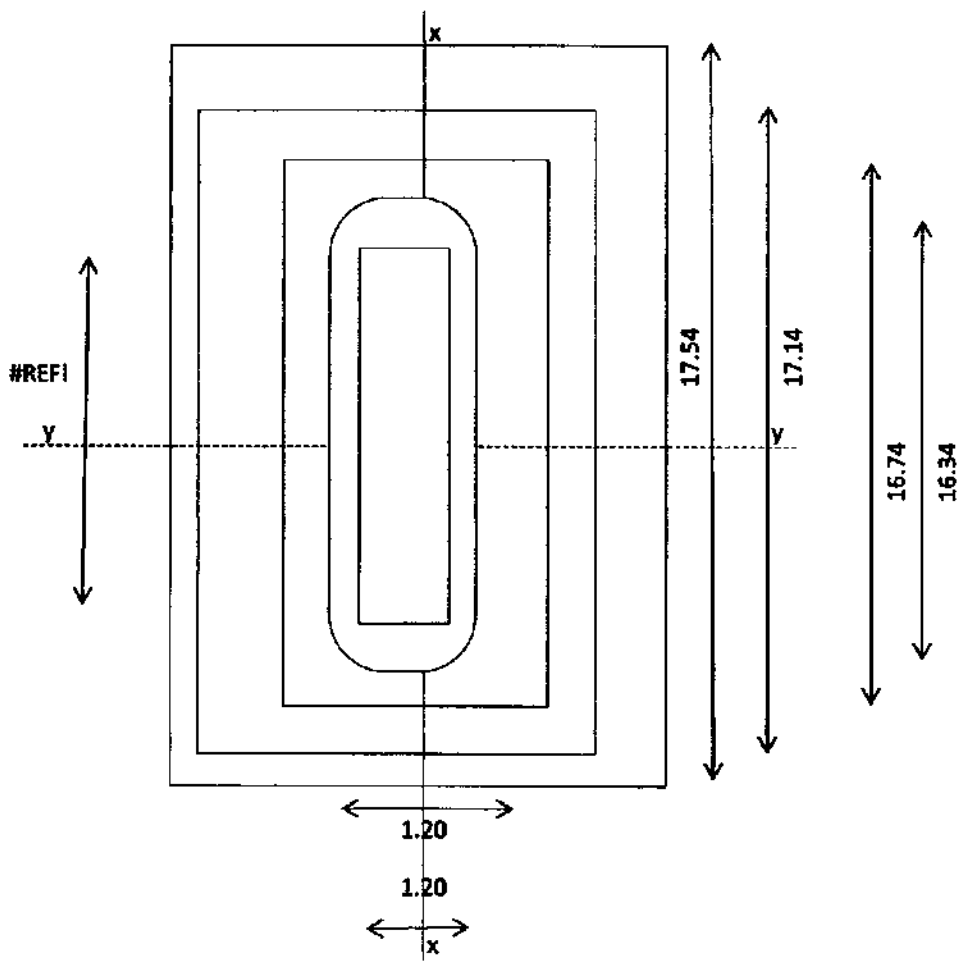
Height = 5.6 m

Density of Plain CC = 2.4 t/m^3 Ref. IRC - 6 clause 205(11)

Weight of pier Upto Junc = 19.30 x 4.9 x 2.4

Weight of pier Above Junc = 19.2984 x 0.70 x 2.4

= 259.37 t



b. **Pier Cap**

volume = 1.2 x 16.34 + 0.785 x 1.2^2 x 0.3

= 6.65 m^3

wt. of pier cap = 6.65 x 2.4

= 15.96 t

wt. of pier + pier cap = 275.33 t

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1.14 **Checking of pier at foundation level**

Properties of the pier section at foundation level
moment of inertia along xx axis

$$Ixx = \frac{bd^3}{12}$$

$$= \frac{17.14 \times 2.40^3}{12}$$

$$= 19.7 \ m^4$$

$$Iyy = \frac{db^3}{12}$$

$$= \frac{2.40 \times 17.14^3}{12}$$

$$= 1007.1 \ m^4$$

$$Zxx = \frac{I\,xx}{y/2} = \frac{19.7}{2.40/2}$$

$$= 16.4544 \ m^3$$

$$Zyy = \frac{I\,yy}{x/2} = \frac{1007.1}{17.14/2}$$

$$= 117.512 \ m^3$$

1.15 **Braking Force**

= 14.00 (Refer Para 1.8)

point of application form foundation level
= 4.80 + 1.2
= 6 m

moment = 14 x 6
= 84.00 t-m

1.16 **wind force**

Case I when Canal Is full

a. Wind force on live load = 2.46 t (Refer para 1.9.0)

point of application form foundation level
= 8.25 + 1.2
Moment = 2.5 x 9.45
= 23.247 t-m

b. wind force on the sub & super structure (Refer para 1.9.0 b)

wind force = 1.227 t

point of application above foundation level

= 6.72 + 1.2 = 7.9 m

Moment = 1.227 x 7.9

= 9.71784 t-m

Case II when Canal is empty

a. Wind force on live load = same as above in case I

b. wind force on the sub & super structure

wind force = 1.23 t (Refer para 1.9.0 b)

point of application above foundation level

= 6.13 + 1.2 = 7.3 m

moment = 1.23 x 7.33

= 9.0159 t-m

1.17 Water Current

Case I when Canal full

a. force due to water current parallel to length of pier = 0.48969 t (same as at junction level)

acting at 1.27 + 1.2 = 2.47 m above foundation level

moment = 0.48969 x 2.47

= 1.20955 t-m

b Moment due water current perpendicular to the length of the pier = 1.77254 t

(same as ti junction level) acting at = 1.267 m above foundation level.

moment = 1.77254 x 1.267

= 2.246 t-m

Case II when Canal is empty :-

There will be no water current acting on the pier.

1.18 Buoyancy at foundation level

Case I When canal is full

volume of pier section between FSL & CBL

$$= \frac{19.2984 + 19.2984}{2} \times 3.80$$

= 73.3339 M^3 .....(1)

volume of first footing = 1.60 x 16.74 x 0.3

= 8.0352 M^3 .....(2)

volume of second footing = 2.00 x 17.14 x 0.3

= 10.284 M^3 .....(3)

volume of Third footing = 2.40 x 17.54 x 0.3

= 12.6288 M^3 .....(4)

volume of earth over foundation concrete

= 2.40 x 17.54 x 0.9 - (Sum of (2)& (3)&(4)

= 37.8864 - 30.948

= 6.9384 m^2 .....(5)

total volume of submurged portion pf pier, footing, foundation concrete & earth

sum of (1) to (5) = 111.22 cum which will be created buoyance force of 111.22 t

upward

1.19 **Dead wieght of water over foundation**

= 2.40 x 17.54 x 3.8 - 73.3339

= 159.965 - 73.3339

= 86.63 t

1.20 **Dead wieght of earth over foundation**

volume of earth = 6.9384 cum (refer 1.18)

Density of earth = 1.8 t/cum

weight of earth = 6.9384 x 1.8

= 12.48912 t

1.21 **Dead wieght of footing & foundation concrete**

volume of first footing = 1.60 x 16.74 x 0.3

= 8.0352 M^3 .....(3)

volume of second footing = 2.00 x 17.14 x 0.3

= 10.284 M^3 .....(4)

volume of Third footing = 2.40 x 17.54 x 0.3

= 12.6288 M^3 .....(5)

Total volume of footing & foundation concrete = 30.948 M^3

Dead wieght of footing & foundation concrete =

wt. = 30.948 x 2.3 = 71.1804 t

1.22 **cheking of stresses at foundation level :**

S. No.	item	case I	case II	reference
1	Dead load of superstructure	101.58 t	101.58 t	1.7.1
2	Dead load of pier & pier cap	275.33 t	275.33 t	1.11.3
3	live load reaction	69.01 t	69.01 t	1.7.2
4	weight of water	86.63 t	nil	1.19

5	Dead weight of earth	12.48912 t	12.4891 t	1.20
6	Dead weight of footing &	71.1804 t	71.1804 t	1.21
7	foundation concrete			
8	Buoyancy (-)	111.2203 t	nil	1.18
Total direct load W		504.999	529.589	

for Mxx

S. No.	Item	case I	case II	reference
1	longitudnal eccentricity	8.365 tm	8.365 tm	1.7.3
2	braking force moment	84.00 tm	84.00 tm	1.15
3	water current perpendicular to length of pier	2.246 tm	nil	1.17(b)
longitudnal moment Mxx		94.611	92.365	

for Myy

S. No.	Item	case I	case II	reference
1	transverse eccentricity	341.6 tm	341.6 tm	1.7.4
2	wind on live load reaction	23.247 tm	23.247 tm	1.15
3	wind on sub & super structure	9.71784 tm	9.0159 tm	1.16(b)
4	water current parallel to length of pier	1.209546 tm	nil	1.17(a)
transverse moment Myy		375.774	373.86	

now,

$$P = \frac{W}{A} \pm \frac{Mxx}{Zxx} \pm \frac{Myy}{Zyy}$$

A = 42.096 m^2
Zxx = 16.4544 m^3
Zyy = 117.512 m^3

case I :

$$P = \frac{504.999}{42.096} \pm \frac{94.611}{16.4544} \pm \frac{375.774}{117.5118}$$

$$= 12 \pm 5.7 \pm 3.197754$$

Pmax = 20.944 t/m^2
= 2.0944 kg/m^2 (comp.)

Pmin = 3.04873 t/m^2
= 0.30487 kg/m^2 (comp.)

case II :

$$P = \frac{529.59}{42.10} \pm \frac{92.37}{16.45} \pm \frac{373.86}{117.51}$$

$$= 13 \pm 5.6 \pm 3.2$$

Pmax = 21.3754 t/m^2
= 2.13754 kg/m^2 (comp.)

Pmin = 3.78562 t/m^2

= 0.37856 kg/m^2 (comp.)

As per IRC 21-2000 for plain cement concrete bridges clause 303.1 table 9, the allowable flexural compressive stress in compression for M-15 grade concrete is 50 kg/cm^2 or 5 Mpa.

As per IRC 21-2000 for plain cement concrete bridges clause 303.3 table 11, the allowable tensile stress for M-15 grade concrete is 4 kg/cm^2 or 0.4 Mpa.

Hence safe

1.23 **CHECK FOR SLIDING ALONG LENGTH OF PIER**

Horizontal forces

Case I Canal full

force of water current parallel to length of pier = 0.48969 t (Ref. 1.17 (a)

wind force = 1.23 t (Ref. 1.16(b)

vertical loads = 505.00 t (Ref. 1.22)

sliding force = 1.71969 t a + b

$$\text{F. S. Against sliding} = \frac{505.00}{1.71969}$$

= 293.656

Greater than 1.5 (Safe)

(Refer IRC 78-1979 cl.706.2.2)

Case II Canal is empty

vertical load = 529.59 t (Ref. 1.22)

sliding forcre due to wind = 1.23 t (same the above)

$$\text{F.S.} = \frac{529.59}{1.23} = 430.5599$$

greater than 1.5 (safe)

1.24 **Check for sliding across length of pier :-**

case I Canal full

sliding force = 1.77254 t due to water current (ref. 1.17 (b)

vertical load = 504.999 t (ref. 1.22)

F.S. against sliding $= \frac{504.9993}{1.772539}$

$= 284.9016 > 1.5$

Hence Safe

case II Canal empty

there is no force causing sliding.

1.25 **chek for overturning (along the length of pier)**

case I canal full

a. water current force = 0.489695 t (ref. 1.17 a)
point of application is 2.47 m above foundation level.

overturning moment = 0.489695 x 2.47
= 1.209546 tm

b. wind force = 1.227 t
point of application is 7.33 m above foundation level.
(ref. 1.16 b)

overturning moment = 1.227 x 7.33
= 8.99391 tm

c. transverse eccentric load = 69.01 t (ref. 1.7.4)
its eccentricity = 4.95 m from centre

or $\frac{17.14}{2}$ - 4.95 = 3.62 m from toe

moment = 69.01 x 3.62
= 249.816 tm (stablising)

d. vertical load acting at centre of pier = 505.00 - 69.01
= 435.989 t

stablising moment = $\frac{435.9893 \times 17.14}{2}$ = 3736.4 tm

total stablising moment = 3736.4 + 249.816
= 3986.24 tm

total overturning moment = (a+b)
= 1.209546 + 8.99391
= 10.20346

factor of safety against over turning = $\frac{3986.24}{10.2035}$

= 390.676 > 2

Hence Safe
ref. IRC 78-1979 Cl 706.2.2)

Case II when canal is empty

a. wind force = 1.227 t acting at 7.92 m above foundation level (ref. 1.16 b)

overturning moment = 1.227 x 7.92 = 9.7 tm

b. Stablising moment due to transverse eccenticity = 249.816 tm same as in case I

C. Stablising moment due to vertical load acting at centre of pier.

$$= 529.59 - 69.01 \times \frac{17.14}{2}$$

$$= 3947.16 \text{ tm}$$

$$\text{F. S. Against overturing} = \frac{249.8162 + 3947.16}{9.71784}$$

$$= 431.8836 > 2$$

Hence Safe

1.26 Check for overturning (Across length of pier)

Case I Canal full

a. water currrent

force = 1.772539 t (ref. 1.17 (b)

Point of application = 2.47 m above foundation level

Over turning moment = 1.772539 x 2.47

= 4.378172 tm

b. vertical loads acting at centre of pier

= 505.00 t (ignoring longitudinal eccentric load as its effect is negligible)

(ref. 1.22)

$$\text{stablishing moment} = 504.9993 \times \frac{2.00}{2}$$

$$= 504.9993 \text{ tm}$$

$$F.S = \frac{504.9993}{4.378172}$$

$$= 115.3448 > 2$$

Hence Safe

Case II when Canal is empty

There will be no force causing overturning.

OFFSHORE STRUCTURES (I) PVT. LTD.

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SATNA NAGOD BRANCH CANAL KM. 55.600 KM. TO 83.00 KM.

Abstract of Branch Canal N.H. AT R.D. 81400 M.

S.No.	Description	Qty.	Rate	Unit	Amount	UCSR Ref.
1	2	3	4	5	6	7
1	Earth work in excavation of foundation of structures as per drawing and technical specification, including setting out, construction of shoring and bracing, removal of stumps and other deleterious matter, dressing of sides and bottom as per relevant clauses of section 300 & 2100 in					
	Ordinary Soil Depth Up to 3 m.	1612.934	61	Cum	98389	12.1 I (i)
	Ordinary Rock Depth Up to 3 m.	868.503	77	Cum	66875	12.1 II (i)
2	Providing and laying Plain/Reinforced cement concrete in open foundation including form work shuttering etc. complete as per drawing and technical specifications and as per relevant clauses of sections 1500, 1700 & 2100 with .) PCC GRADE M15	187.868	4617	Cum	867387	12.6
3	Supplying, fitting and placing HYSD bar reinforcement in super- structure complete as per drawing and technical specifications as per relevant clauses of section 1600 FE550	59.939	82810	tonne	4963511	14.4
4	Providing and Placing Reinforced/Prestressed cement concrete in super-structure e/x reinforcement as per drawing and Technical Specification and as per relevant clauses of sections 1500, 1700 and 2300 in **RCC GRADE M 20**	653.322	5674	Cum.	3706949	14.1 (A) (i) 2
5	Providing and Placing Reinforced/Prestressed cement concrete in super-structure e/x reinforcement as per drawing and Technical Specification and as per relevant clauses of sections 1500, 1700 and 2300 in **RCC GRADE M 25**	688.489	6286	Cum.	4327842	14.1 (B) (i) 2
6	Providing and laying Cement concrete wearing coat M-30 grade including reinforcement complete as per drawing and Technical Specifications and as per relevant clauses of sections 1500, 1700 and Clause 2702 of specifications..	56.196	11685	Cum.	656650	14.6
7	Fillar joint Providing & fixing 20 mm thick compressible fibre board in expansion joint complete as per drawing & Technical Specification.	57.720	26	Rm	1501	14.19 (iV)
8	Providing weep holes in Brick masonry/Plain/Reinforced concrete abutment, wing wall/return wall with 100 mm dia AC pipe, extending through the full width of the structure with slope of 1V :20H towards drawing foce. Complete as per drawing and Technical specifications	113.310	185	Rm	20962	13.9
9	Earth work in excavation of foundation of structures as per drawing and technical specification, including setting out, construction of shoring and bracing, removal of stumps and other deleterious matter, dressing of sides and bottom as per relevant clauses of section 300 & 2100 inBack Filling in Marshy Foundation Pits	454.214	308	Cum	139898	12.1 (Vi)

S.No.	Description	Qty.	Rate	Unit	Amount	UCSR Ref.
10	Embankment Construction with Material Obtained from Borrow Pits Construction of embankment with approved material having CBR>7 obtained from borrow pits with all lifts and leads, transporting to site, spreading, grading to required slope and compacting to meet requirement of table 300-1, 300-2 and as per relevent clauses of section-300.	450.000	155	Cum.	69750	3.13
11	Granular Sub-base with Well Graded Material (CBR>30 or more) (Table:- 400-1 & Table 400-2) Construction of granular sub-base by providing well graded material like natural sand crushed gravel or crushed stone having CBR >30, spreading in uniform layers with motor grader on prepared surface, mixing by mix in place method with rotavator or plant mix method at OMC, and compacting with vibratory rollers of 80 to 100 kN static weight to achieve the desired density, complete as per Clause 401 of Specification.	212.035	934	Cum	198040	4.1
12	Water Bound Macadam Providing, laying, spreading and compacting stone aggregates of specific sizes to water bound macadam specification including spreading in uniform thickness, hand packing, rolling with vibratory roller 8-10 tonnes in stages to proper grade and camber, applying and brooming requisite type of screening/ binding Materials to fill up the interstices of coarse aggregate, watering and compacting to the required density as per clause 404 of specification.	90.000	1347	Cum	121230	4.8 i (a)
13	Water Bound Macadam Providing, laying, spreading and compacting stone aggregates of specific sizes to water bound macadam specification including spreading in uniform thickness, hand packing, rolling with vibratory roller 8-10 tonnes in stages to proper grade and camber, applying and brooming requisite type of screening/ binding Materials to fill up the interstices of coarse aggregate, watering and compacting to the required density as per clause 404 of specification.	67.500	1250	Cum.	84375	4.8 ii (a)
	Total				15331299	
	Say				153.31	Lakhs
	Add 18% GST				27.5963	
	Total Amount				180.9093	Lakhs

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SATNA NAGOD BRANCH CANAL KM. 55.600 KM. TO 83.00 KM.

ESTIMATE

BRANCH CANAL N.H. AT R.D. 81400 M.

UCSR Item No.	Item of Work	Nos.	L	B	H/D	Quantity	REMARKS	
12.1	Earth work in excavation of foundation of structures as per drawing and technical specification, including setting out, construction of shoring and bracing, removal of stumps and other deleterious matter, dressing of sides and bottom as per relevant clauses of section 300 & 2100 in						AVG. top GL	Excavation G.L.
	Pier P1 & P2	4	18.64	3.50	7.08	1846.29	345.120	338.045
	Abutment A1 & A2	4	17.54	3.45	2.62	635.14	345.120	342.496
	Total					**2481.436**		**Cum.**
I (I)	Ordinary Soil Depth Up to 4.0 m.					**1612.934**		**Cum.**
II (I)	Ordinary Rock Depth Up to 3 m.					**868.503**		**Cum.**
12.6	**Providing and laying Plain/Reinforced cement concrete in open foundation including form work shuttering etc. complete as per drawing and technical specifications and as per relevant clauses of sections 1500, 1700 & 2100 with .) PCC GRADE M15**							
	Pier P1 & P2	4	17.64	2.50	0.10	17.640		
	Abutment A1 & A2	4	16.54	2.45	0.10	16.209		
	Pier P1 & P2 PCC	4	17.54	2.40	0.30	50.515		
	Abutment A1 & A2 PCC	4	16.44	2.35	0.30	46.361		
	Approach Pier	4	14.43	0.80	0.20	9.235		
	Approach Slab PCC	4	14.43	3.70	0.15	32.035		
	Approach toe wall	4	14.43	0.50	0.55	15.873		
	Total					**187.868**		**Cum.**
14.4	**Supplying, fitting and placing HYSD bar reinforcement in super- structure complete as per drawing and technical specifications as per relevant clauses of section 1600 FE550**							
	Pier P1 , P2 & A1 , A2					5197.590		As per BBS
	Total					**5197.590**		**Kg.**
14.1 (A) (i) 2	**Providing and Placing Reinforced/Prestressed cement concrete in super-structure e/x reinforcement as per drawing and Technical Specification and as per relevant clauses of sections 1500, 1700 and 2300 in RCC GRADE M 20**							
	Pier P1, P2 Footing 1	4	17.14	2.00	0.30	41.136		
	Pier P1,P2 Footing 2	4	16.74	1.60	0.30	32.141		
	Abutment A1 & A2	4	16.01	1.95	0.30	37.452		
	Pier P1 .P2 Ractangular	4	15.14	1.20	5.60	406.963		
	Pier (P1 & P 2) Circular Portion area (πr^2)=3.14*0.6*0.6	4	3.14	0.6x0.6	5.60	25.337		
	Abutment A1 & A2	4	15.13	1.33	1.15	92.137		
	Abutment A1 & A2 top box	4	15.13	1.00	0.30	18.156		
	Total					**653.322**		**Cum.**
14.4	**Supplying, fitting and placing HYSD bar reinforcement in super- structure complete as per drawing and technical specifications as per relevant clauses of section 1600 FE550**							
	Slab & Pier Cap					49024.000		As per BBS
	Approch Slab & wearing coat					5716.960		As per BBS
	Total					**54740.960**		**Kg.**

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UCSR Item No.	Item of Work	Nos.	L	B	H/D	Quantity	REMARKS	
4.1	**Granular Sub-base with Well Graded Material (CBR>30 or more) (Table:- 400-1 & Table 400-2)** Construction of granular sub-base by providing well graded material like natural sand crushed gravel or crushed stone having CBR >30, spreading in uniform layers with motor grader on prepared surface, mixing by mix in place method with rotavator or plant mix method at OMC, and compacting with vibratory rollers of 80 to 100 kN static weight to achieve the desired density, complete as per Clause 401 of Specification.							
	GSB 150mm thick	4	14.43	3.70	0.15	32.035		
	GSB 200 mm thick	1	120.00	7.50	0.20	180.000		
	Total					**212.035**		**Cum**
4.8 i (a)	**Water Bound Macadam** Providing, laying, spreading and compacting stone aggregates of specific sizes to water bound macadam specification including spreading in uniform thickness, hand packing, rolling with vibratory roller 8-10 tonnes in stages to proper grade and camber, applying and brooming requisite type of screening/ binding Materials to fill up the interstices of coarse aggregate, watering and compacting to the required density as per clause 404 of specification.							
	(i) Grading I (63 to 45 mm) (a) Using Screening Type A (13.2 mm Agg.)	1	120.00	7.50	0.10	90.000		
	Total					**90.000**		**Cum**
4.8 ii (a)	**Water Bound Macadam** Providing, laying, spreading and compacting stone aggregates of specific sizes to water bound macadam specification including spreading in uniform thickness, hand packing, rolling with vibratory roller 8-10 tonnes in stages to proper grade and camber, applying and brooming requisite type of screening/ binding Materials to fill up the interstices of coarse aggregate, watering and compacting to the required density as per clause 404 of specification.							
	(ii) Grading II (53 to 22.4 mm) (a) Using Screening Type B (11.2 mm Agg.)	1	120.00	7.50	0.075	67.500		
	Total					**67.500**		**Cum**

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UCSR Item No.	Item of Work	Nos.	L	B	H/D	Quantity	REMARKS	
14.1 (B) (i)	Providing and Placing Reinforced/Prestressed cement concrete in super-structure e/x [illegible] as per drawing and Technical Specification and as per relevant clauses of							
2	sections 1500, 1700 and 2300 in RCC GRADE M 25							
	Pier Cap Ractangular Portion	4	15.14	1.30	0.30	23.618		
	Pier Cap Circular Portion	4	3.14	0.65x0.65	0.30	1.593		
	Abutment bed block	4	15.13	1.00	0.30	18.156		
	Abutment Dirt wall	4	15.13	0.500	0.675	20.426		
	Centre Slab	2	12.50	9.51	0.68	160.481		
	B/s End Slab	4	12.50	9.31	0.68	314.213		
	Footpath	2	2.00	28.17	0.38	43.044		
	Perapet Wall	2	0.20	28.17	0.64	7.155		
	Crash barrier	4	28.17	Area=.2936		33.083		
	Approach Slab	4	14.43	3.70	0.30	64.069		
	Protection wall	2	4.91	0.30	0.90	2.651		
	Total					**688.489**		**Cum**
14.19 (iv)	Fillar joint Providing and filling joint sealing compound as per drawings and technical specifications with coarse sand and 6% bitumen by weight							
	expemsion Joint	4	14.43			57.720		
	Total					**57.720**		**RM**
14.6	Providing and laying Cement concrete wearing coat M-30 grade including reinforcement complete as per drawing and Technical Specifications and as per relevant clauses of sections 1500, 1700 and Clause 2702 of specifications..							
	Wearing coat	2	29.33	9.60	0.07	42.235		
	Approach Wearing coat	4	11.08	4.20	0.08	13.961		
	Total					**56.196**		**Cum**
12.1 (Vi)	Earth work in excavation of foundation of structures as per drawing and technical specification, including setting out, construction of shoring and bracing, removal of stumps and other deleterious matter, dressing of sides and bottom as per relevant clauses of section 300 & 2100 inBack Filling in Marshy Foundation Pits							
	Pier P1 & P2	4	18.64	2.00	2.00	298.240		
	A1 & A2	4	16.60	1.00	2.35	155.974		
	Total					**454.214**		**Cum.**
13.9	Providing weep holes in Brick masonry/Plain/Reinforced concrete abutment, wing wall/return wall with 100 mm dia AC pipe, extending through the full width of the structure with slope of 1V :20H towards drawing foce. Complete as per drawing and Technical specifications							
	Service duct	3	28.17			84.510		
	Weep Hole	24	1.20			28.800		
	Total					**113.310**		**RM**
	Diverted Road							
3.13	Embankment Construction with Material Obtained from Borrow Pits Construction of embankment with approved material having CBR>7 obtained from borrow pits with all lifts and leads, transporting to site, spreading, grading to required slope and compacting to meet requirement of table 300-1, 300-2 and as per relevent clauses of section-300.							
	Embankment Construction	1	120.00	12.50	0.30	450.000		
	Total					**450.000**		**Cum**

GOVERNMENT OF MADHYA PRADESH

NARMADA VALLEY DEVELOPMENT AUTHORITY

BARGI DIVERSON PROJECT

NAGOD SATNA BRANCH CANAL FROM RD 55.600KM TO RD 83.00KM INCLUDING DISTRIBUTION SYSTEM

MOHARI DY N.H. CROSSING AT RD - 8025 M
OFFTAKE FROM 59375 M OF N.S.B.C.

Prepared & Submitted By :

OFFSHORE INFRASTRUCTURES LIMITED, MUMBAI

Design of MOHARI DY N.H. CROSSING AT RD - 8025 M

CANAL DATA :-

1	Full Supply Discharge		(Q)	=	1.1836	Cumec
2	Bed Width		(B.W.)	=	0.8	M
3	Full Supply Depth		(F.S.D.)	=	0.75	M
4	Free Board		(F.B.)	=	0.50	M
5	Top Width of Bank :	Left		=	1.50	M
		Right		=	1.50	M
6	Bed Slope			=	1 in 1100	
7	Side Slope :	Inner Slope	(I)	=	1.50 :1	
		Outer Slope	(O)	=	2.00 :1	
8	Velocity		(V)	=	0.927	M/Sec
9	Manning's "N"	Lined	(n)	=	0.018	
		Unlined	(n)	=	0.025	
10	Canal Bed Level		(C.B.L.)	=	328.506	M
11	Full Supply Level		(F.S.L.)	=	329.256	M
12	Top Bank Level		(T.B.L.)	=	329.756	M

BRIDGE DATA :-

1	Formation Level	(F.R.L.)	=	329.600	M
2	Ground Level	(G.L.)	=	329.300	M
3	Clear Width of Roadway		=	29.1	M
4	Pipe Length		=	30	M
5	Extra Beam Width		=	0.000	M
6	Extra Beam Height		=	0.000	M
7	Extra Beam Length		=	0.000	M
8	Extra Beam Rest on Pipe		=	0.000	M
9	Overall Length		=	30.000	M
10	Pipe Invert Level in U/s		=	327.006	M
11	Pipe Invert Level in D/s		=	326.964	M
12	D/s CBL	(C.B.L.)	=	328.406	M
13	D/s FSL	(F.S.L.)	=	329.156	M
14	D/s TBL	(T.B.L.)	=	329.656	M
15	BT RL		=	325.81	M

DESIGN OF PIPE FOR DISCHARGE :-

X- sectional area of Canal water way

Bed Width		=	0.80	M
Full Supply Depth		=	0.75	M
Water way	(A)	=	(0.8 + 1.5 x 0.75) x 0.75	
		=	1.44	Sq mts
Velocity	V_1	=	0.927	M/Sec

Water in pipe will run as open channel flow

Assume diameter of pipe = 1.20 M

Hence X- sectional area of one pipe = 1.130 SqM

Manning's rougosity coefficient for RCC Pipe = 0.016

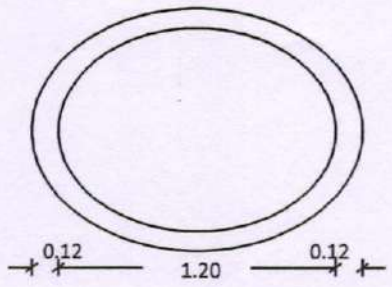
The pipe invert level in u/s = CBL - Depression of pipe

= 328.506 - 1.5

= 327.006 M

(C.B.L.) = 328.506 M

(F.S.L.) = 329.256 M



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Hence net area of one pipe = Total Area
= 1.130
= 1.130 sqm
No. of rows of pipe = 1
By providing one row of pipe, X- sectional area = 1.130 sqm
Full Supply Discharge = 1.184 Cumecs
Hence Velocity through pipe to pass full discharge V_2 = (1.1836 / 1.13)
= 1.047 M/Sec
Total perimeter of one pipe = $2\pi r$
= 3.77 M
= 3.77 M
Hydraulic mean depth of pipe not running full = A /P
= (1.13 / 3.77)
R = 0.300 M
$R^{2/3}$ = 0.448
Slope = $\left(\frac{(V \times n)}{R^{2/3}}\right)^2$
= $\left(\frac{1.047 \times 0.016}{0.448}\right)^2$
Slope = 0.0014
Say = 1 in 714
Length of Pipe = 30.00 M
= $\frac{30.00}{714}$
Drop in pipe = 0.042 M

HEAD LOSS :-

3.1.2 **Head Loss C** Highest value of the following two is adopted

(I) By unwins for = $\frac{(1+f_1+f_2*L/R)V^2}{2g}$

where = 0.505 & f2 = a(1+b/R)

where a & b are as follows (5.11© E-In-C70/1)
For concrete 0.00316 and b = 0.03

R :A/P = 0.300 m
f2 = #REF! = 0.0035

L = Length ofPipe
= 30.000
& her = $1 + 0.505+0.0035 \times (30/0.3) \times \frac{1.05^2}{2 \times 9.81}$
= 0.1040 m

Head loss as per drop of canal = 30 / 714
= 0.042 M
Provided Head Loss in Lsec = 0.1 M
Difference in head loss calculated and provided = 0.104-0.042
= 0.062 M

As there is provision of 0.1m head loss in canal L -section, Hence OK .

SCOUR DEPTH :-

In this case however the canal is lined scour depth need not be calculated. However calculations are given as below:-

When :-

$$d = 1.34\left(\frac{D_b^{\,2}}{K_{sf}}\right)^{1/3}$$

d_{sm} = Mean Depth of Scour

D_b = The design Discharge for Foundation per Meter width of effective waterway.

K_{sf} = Silt Factor fro a representative sample of bed material obtained up to the level of anticipated deepest scour

$K_{sf} = 1.76\sqrt{d_m}$

d_m = Weighted mean diameter in mm.

Particle Size = Heavy Sand

d_m = 1.29

K_{sf} = 1.999

D_b = 0.388

for Abutment

$$d = 1.34\left(\frac{0.388 \times 0.388}{1.999}\right)^{1/3} = 0.422 \text{ M}$$

Max Scour Depth (D_m) = $1.27 \times d_{sm}$ = 1.27×0.422 = 0.54 M

In the present case, F.S.L. = 329.256 M

Hence,

Maximum depth of sour is up to	=	329.256 - 0.54	=	328.720 M
Below G.L. the foundation is provided		1.00 M below G.L.	=	328.300 M
Below Canal Bed, the foundation is provided		1.20 M below INVERT LE	=	325.806 M
Foundation Level of Head Wall	=		=	325.806 M
				Hence Safe

DESIGN OF HEAD WALL:-

The design of Head wall is not done. Its width has been adopted as per chart for wing walls in E-in-C publication 70/1

1	Effective height of wall up to top of foundation level	=	329.6 - 326.106
		=	3.494 M
2	B/H factor as per E in C publication	=	0.65
3	B/H Angle	=	26.84°
4	Width required	=	2.27 M
5	Width provided	=	2.3 M

DESIGN OF WELL IN U/S :

Area of waterway = 1.440 Sqm

Area required for well = 1.25 x Area of waterway

= 1.25 x 1.440

= 1.800 sqm

Min. distance required of fall wall = 1.25D + (h/4) As per E-in-C 70/1

where, D = Depth of Water

h = CBL of canal -U/S invert level of pipe

D = 0.75 m

h = 328.506 - 326.706

= 1.80 m

Min. distance required of fall wall = (1.25 x 0.8) + (1.80 /4)

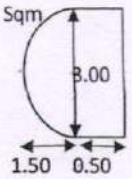
= 1.39 m

Dia. of well provided = width of pipe = 3.00 m

Area of well provided = $\frac{3.14 \times 3.0^{\,2}}{4 \times 2}$

= 3.53 Sqm

Extra area required = 1.80 - 3.5
= -1.733 Sqm



Length required = -1.73 / 3.00
= -0.58 m
say = 0.50 m

stance of well wall from U/s = 1.50 + 0.50
= 2.00 m
> 1.39 m HENCE OK

Depth of water cushion
Provide depth of water cushion with R.C.C. floor = 0.30 m

Floor thickness of well = √(Depth of water + Drop)
= √(4.395 + 5.90)
= 3.21 feet
= 0.98 m
Provide Floor thickness of well = 0.30 m
i.e. provide top floor thickness with R.C.C. 1:2:4= 0.30 m
& remaining floor thickness with C.C. 1:3:6 = 0.30 m

Foundation level of U/S well = U/S Invert level of pipe - water cushion - Floor thickness of well
= 327.006 - 0.30 - 0.30 - 0.30
= 326.106 m
Provide Foundation level of well = 327.006 - 1.20 (1.20m below pipe invert)

Provide Foundation level of well = 325.806 m

DESIG OF NOTCH: Providing Trapezoidal type notch

Notch Width = 0.224 X Q X(WATER DEPTH) $^{-3/2}$
= 0.221 x 41.80 x 2.48 $^{-3/2}$
= 2.37 feet
= 0.72 m
say = 0.8 m

ith of Notch = Bottom width of notch + 2d' TAN α
= 2.62 +2 x 2.48 X M Q $^{-5/2}$
= 2.62 +2 x 2.48 x 0.055 x 42 x x 2.48 $^{-5/2}$
= 3.81 feet
= 1.16 m
= 1.2 m

pitching in outer slope of canal is to be provided.

scharge through not = 4.46 X notch width x FSD $^{1.5}$
= 4.46 x 2.62 x 2.48 $^{1.5}$
= 1.29 cumecs
> 1.184 cumecs

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SATNA NAGOD BRANCH CANAL KM. 55.600 KM. TO 83.00 KM.

Abstract of Mohari Disty N.H. AT R.D. 8025 M.

S.No.	Description	Qty.	Rate	Unit	Amount	UCSR Ref.
1	2	3	4	5	6	7
1	Earth work in excavation of foundation of structures as per drawing and technical specification, including setting out, construction of shoring and bracing, removal of stumps and other deleterious matter, dressing of sides and bottom as per relevant clauses of section 300 & 2100 in					
	Ordinary Soil Depth Up to 3 m.	421.996	61	Cum	25742	12.1 I (i)
2	Providing and laying Plain/Reinforced cement concrete in open foundation including form work shuttering etc. complete as per drawing and technical specifications and as per relevant clauses of sections 1500, 1700 & 2100 with .) PCC GRADE M15	144.803	4617	Cum	668554	12.6
3	Supplying, fitting and placing HYSD bar reinforcement in super- structure complete as per drawing and technical specifications as per relevant clauses of section 1600 FE550	2.590	82810	tonne	214441	14.4
4	Providing and Placing Reinforced/Prestressed cement concrete in super-structure e/x reinforcement as per drawing and Technical Specification and as per relevant clauses of sections 1500, 1700 and 2300 in **RCC GRADE M 20**	3.770	5674	Cum.	21393	14.1 (A) (i) 2
5	Providing and Placing Reinforced/Prestressed cement concrete in super-structure e/x reinforcement as per drawing and Technical Specification and as per relevant clauses of sections 1500, 1700 and 2300 in **RCC GRADE M 25**	31.879	6286	Cum.	200393	14.1 (B) (i) 2
6	Providing weep holes in Brick masonry/Plain/Reinforced concrete abutment, wing wall/return wall with 100 mm dia AC pipe, extending through the full width of the structure with slope of 1V :20H towards drawing foce. Complete as per drawing and Technical specifications	7.200	185	Rm	1332	13.9
7	Providing and Laying Reinforced Cement Concrete Pipe NP4/prestrssed concrete pipe on first class bedding in single row. Providing and Laying Reinforced cement concrete pipe NP4/prestrssed concrete pipe for culverts on first class bedding of granular material (cost of bedding included) in single row including fixing collar with cement mortar 1:2 but excluding excavation, protection works, backfilling, concrete and masonry works in head walls and parapets. 1200 mm Dia Pipe	30.000	9544	Rm	286320	9.2 B
8	Earth work in excavation of foundation of structures as per drawing and technical specification, including setting out, construction of shoring and bracing, removal of stumps and other deleterious matter, dressing of sides and bottom as per relevant clauses of section 300 & 2100 inBack Filling in Marshy Foundation Pits	73.985	308	Cum	22788	12.1 (Vi)

9	Embankment Construction with Material Obtained from Borrow Pits Construction of embankment with approved material having CBR>7 obtained from borrow pits with all lifts and leads, transporting to site, spreading, grading to required slope and compacting to meet requirement of table 300-1, 300-2 and as per relevent clauses of section-300.	375.000	155	Cum.	58125	3.13
10	Granular Sub-base with Well Graded Material (CBR>30 or more) (Table:- 400-1 & Table 400-2) Construction of granular sub-base by providing well graded material like natural sand crushed gravel or crushed stone having CBR >30, spreading in uniform layers with motor grader on prepared surface, mixing by mix in place method with rotavator or plant mix method at OMC, and compacting with vibratory rollers of 80 to 100 kN static weight to achieve the desired density, complete as per Clause 401 of Specification.	150.000	934	Cum	140100	4.1
11	Water Bound Macadam Providing, laying, spreading and compacting stone aggregates of specific sizes to water bound macadam specification including spreading in uniform thickness, hand packing, rolling with vibratory roller 8-10 tonnes in stages to proper grade and camber, applying and brooming requisite type of screening/ binding Materials to fill up the interstices of coarse aggregate, watering and compacting to the required density as per clause 404 of specification.	75.000	1347	Cum	101025	4.8 i (a)
12	Water Bound Macadam Providing, laying, spreading and compacting stone aggregates of specific sizes to water bound macadam specification including spreading in uniform thickness, hand packing, rolling with vibratory roller 8-10 tonnes in stages to proper grade and camber, applying and brooming requisite type of screening/ binding Materials to fill up the interstices of coarse aggregate, watering and compacting to the required density as per clause 404 of specification.	56.250	1250	Cum.	70313	4.8 ii (a)
	Total				1810525	
	Say				**18.11**	Lakhs
	Add 18% GST				**3.2589**	
	Total Amount				**21.3642**	**Lakhs**

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SATNA NAGOD BRANCH CANAL KM. 55.600 KM. TO 83.00 KM.

ESTIMATE

MOHARI DISTY N.H. AT R.D. 8025 M.

UCSR Item No.	Item of Work	Nos.	L	B	H/D	Quantity	REMARKS	
12.1	Earth work in excavation of foundation of structures as per drawing and technical specification, including setting out, construction of shoring and bracing, removal of stumps and other deleterious matter, dressing of sides and bottom as per relevant clauses of section 300 & 2100 in						AVG. top GL	Excavation G.L.
	Head Wall U/S	1	6.55	2.70	3.59	63.56	329.300	325.706
	Well Wall U/S	1	3.14	3.85	3.49	42.27	329.300	325.806
	Head Wall D/S	1	6.55	2.70	3.59	63.56	329.300	325.706
	Well Wall D/S	1	3.14	3.85	3.49	42.27	329.300	325.806
	Pipe Barral	1	25.00	3.04	2.72	206.45	329.300	326.584
	U/s Key wall	1	2.10	0.60	1.49	1.88	329.300	327.806
	D/s Key wall	1	2.10	0.60	1.59	2.01	329.300	327.706
	Total					**421.996**		**Cum.**
I (i)	Ordinary Soil Depth Up to 3 m.					**421.996**		**Cum.**
12.6	Providing and laying Plain/Reinforced cement concrete in open foundation including form work shuttering etc. complete as per drawing and technical specifications and as per relevant clauses of sections 1500, 1700 & 2100 with .) PCC GRADE M15							
	Head Wall U/S	1	5.55	2.70	0.10	1.499		
	Head Wall D/S	1	5.55	2.70	0.10	1.499		
	Pipe Barral	1	26.03	2.04	0.30	15.932		
	Head Wall U/S 1 Step	1	5.45	2.60	0.30	4.251		
	Head Wall U/S 2 Step	1	5.150	(0.525+2.300)/2	3.494	25.42		
	Pipe Deduction in Head wall U/s	-1	1.540	Area=1.629		-2.508		
	Head Wall D/S 1 Step	1	5.45	2.60	0.30	4.251		
	Head Wall D/S 2 Step	1	5.150	(0.525+2.300)/2	3.494	25.42		
	Pipe Deduction in Head wall D/s	-1	1.540	Area=1.629		-2.508		
	Half Pipe Barral	1	26.51	2.04	0.520	28.123		
	Deduct Pipe in half cradel concrerte	-1	26.51	Area=0.530		-14.051		
	Coller Joint	11	2.04	0.30	1.220	8.213		
	Deduct Pipe Barral	-11	0.30	Area=1.255		-4.142		
	Parapet kerb	2	5.15	0.53	0.23	1.217		
	Perapet Wall	2	5.15	0.30	0.68	2.09		
	U/s & D/s well wall Circular pcc	2	3.14	5.61	0.30	10.58		
	U/s & D/s well wall Lift	2	6.28	0.93	3.38	39.24		
	U/s & D/s Notch deduction inwell wall Lift	-2	0.50	1.00	0.75	-0.75		
	U/s & D/s Key wall pcc	2	2.10	0.60	0.20	0.50		
	U/s & D/s Key wall	2	1.80	0.30	0.50	0.54		
	Total					**144.803**		**Cum.**

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14.4	Supplying, fitting and placing HYSD bar reinforcement in super- structure complete as per drawing and technical specifications as per relevant clauses of section 1600 FE550							
	Head Wall							
	Main Bar 10 MM Dia @ 200 mm	26	4.614		0.617	74.02		
	Disty Bar 8 MM Dia @ 200 mm	23	5.08		0.395	46.15		
	Total					120.17		
	2 Nos Headwall					240.34		
	Slab							
	Main Bar 12 MM Dia @ 150 mm	384	3.212		0.888	1095.27		
	Disty Bar 12 MM Dia @ 300 mm	22	28.72		0.888	561.07		
	Crash Barrier							
	Main Bar 12 MM Dia @ 150 mm	20	3.104		0.888	55.13		
	Main Bar 12 MM Dia @ 150 mm	20	1.93		0.888	34.28		
	Disty Bar 10 MM Dia @ 150 mm	18	2.79		0.617	30.99		
	Total					120.39		
	2 Nos Crash Barrier					240.78		
	Wearing coat							
	Main Bar 8 MM Dia @ 200 mm	15	8.32		0.395	49.30		
	Disty Bar 8 MM Dia @ 200 mm	43	2.75		0.395	46.71		
	Total					96.00		
	2 Nos Wearing coat					192.01		
	U/s & D/s well							
	Main Bar 10 MM Dia @ 300 mm	22	3.60		0.617	48.80		
	Disty Bar 8 MM Dia @ 300 mm	12	6.184		0.395	29.31		
	Main Bar 12 MM Dia @ 300 mm	18	2.044		0.888	32.67		
	Disty Bar 12 MM Dia @ 300 mm	18	1.205		0.888	19.26		
	Total					130.04		
	2 Nos Well Wall					260.09		
	Grand Total					**2589.553**		**Kg.**
14.1 (A) (i) 2	Providing and Placing Reinforced/Prestressed cement concrete in super-structure e/x reinforcement as per drawing and Technical Specification and as per relevant clauses of sections 1500, 1700 and 2300 in RCC GRADE M 20							
	U/s RCC Flooring of well	1	3.14	2.000	0.300	1.89		
	D/s RCC Flooring of well	1	3.14	2.000	0.300	1.89		
	Total					**3.770**		**Cum.**
14.1 (B) (i) 2	Providing and Placing Reinforced/Prestressed cement concrete in super-structure e/x reinforcement as per drawing and Technical Specification and as per relevant clauses of sections 1500, 1700 and 2300 in RCC GRADE M 25							
	Top Slab	1	3.04	28.80	0.30	26.264		
	Crash barrier	2	3.04	Area=.2936		1.785		
	Wearing coat	2	3.04	8.40	0.07	3.830		
	Total					**31.879**		**Cum**

9.2(B)	Providing and Laying Reinforced Cement Concrete Pipe NP4/prestrssed concrete pipe on first class bedding in single row. Providing and Laying Reinforced cement concrete pipe NP4/prestrssed concrete pipe for culverts on first class bedding of granular material (cost of bedding included) in single row including fixing collar with cement mortar 1:2 but excluding excavation, protection works, backfilling, concrete and masonry works in head walls and parapets.							
	1200 MM Dia NP4 PIPe	12	2.50			**30.000**		**RM.**
13.9	Providing weep holes in Brick masonry/Plain/Reinforced concrete abutment, wing wall/return wall with 100 mm dia AC pipe, extending through the full width of the structure with slope of 1V :20H towards drawing foce. Complete as per drawing and Technical specifications							
	Weep Hole	8	0.90			7.200		
	Total					**7.200**		**RM**
12.1 (Vi)	Earth work in excavation of foundation of structures as per drawing and technical specification, including setting out, construction of shoring and bracing, removal of stumps and other deleterious matter, dressing of sides and bottom as per relevant clauses of section 300 & 2100 inBack Filling in Marshy Foundation Pits							
	Head Wall U/S	1	4.81	0.99	3.19	15.156		
	Head Wall D/S	1	4.81	0.99	3.19	15.156		
	Pipe Barral	1	1.00	25.10	1.74	43.674		
	Murrum filling	1	2.04	28.18	0.98	56.101		
	Total					**73.985**		**Cum.**
	Diverted Road							
3.13	Embankment Construction with Material Obtained from Borrow Pits Construction of embankment with approved material having CBR>7 obtained from borrow pits with all lifts and leads, transporting to site, spreading, grading to required slope and compacting to meet requirement of table 300-1, 300-2 and as per relevent clauses of section-300.							
	Embankment Construction	1	100.00	12.50	0.30	375.000		
	Total					**375.000**		**Cum**
4.1	**Granular Sub-base with Well Graded Material (CBR>30 or more) (Table:- 400-1 & Table 400-2)** Construction of granular sub-base by providing well graded material like natural sand crushed gravel or crushed stone having CBR >30, spreading in uniform layers with motor grader on prepared surface, mixing by mix in place method with rotavator or plant mix method at OMC, and compacting with vibratory rollers of 80 to 100 kN static weight to achieve the desired density, complete as per Clause 401 of Specification.							
	GSB 200 mm thick	1	100.00	7.50	0.20	150.000		
	Total					**150.000**		**Cum**
4.8 i (a)	**Water Bound Macadam** Providing, laying, spreading and compacting stone aggregates of specific sizes to water bound macadam specification including spreading in uniform thickness, hand packing, rolling with vibratory roller 8-10 tonnes in stages to proper grade and camber, applying and brooming requisite type of screening/ binding Materials to fill up the interstices of coarse aggregate, watering and compacting to the required density as per clause 404 of specification.							
	(i) Grading I (63 to 45 mm) (a) Using Screening Type A (13.2 mm Agg.)	1	100.00	7.50	0.10	75.000		
	Total					**75.000**		**Cum**

4.8 ii (a)	**Water Bound Macadam** Providing, laying, spreading and compacting stone aggregates of specific sizes to water bound macadam specification including spreading in uniform thickness, hand packing, rolling with vibratory roller 8-10 tonnes in stages to proper grade and camber, applying and brooming requisite type of screening/ binding Materials to fill up the interstices of coarse aggregate, watering and compacting to the required density as per clause 404 of specification.							
	(ii) Grading II (53 to 22.4 mm) (a) Using Screening Type B (11.2 mm Agg.)	1	100.00	7.50	0.075	56.250		
	Total					**56.250**		**Cum**

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GOVERNMENT OF MADHYA PRADESH

NARMADA VALLEY DEVELOPMENT AUTHORITY

BARGI DIVERSON PROJECT

NAGOD SATNA BRANCH CANAL FROM RD 55.00 KM TO RD 83.00 KM INCLUDING DISTRIBUTION SYSTEM OF BARGI DIVERSION PROJECT

NH CROSSING AT RD 7100 M
UMARHAT DISTY OFFTAKE FROM 60125 M OF N.S.B.C FROM RD 55.00KM TO 83.00KM

Prepared & Submitted By :

OFFSHORE INFRASTRUCTURES LIMITED, MUMBAI

DESIGN OF NH CROSSING AT RD 7100 OF UMARHATDISTRIBUTARY

CANAL DATA

1	Full Supply Discharge (Design Discharge)	Q	=	3.1865	Cumecs
2	Bed Width	BW	=	1.05	M
3	Full Supply Depth	FSD	=	1	M
4	Free Board	FB	=	0.6	M
5	Canal Side Slope	SS	=	1.5 : 1	
6	Canal Bed Slope	BS	=	1 in 700	
7	Velocity	V	=	1.406	M/Sec.
8	Value Of 'N'	N	=	0.018	
9	Top Width Of Bank's	R/L	=	1.5 4	M
10	Canal Bed Level	CBL	=	338.749	M
11	Full Supply Level	FSL	=	339.749	M
12	T.B.L.	TBL	=	340.349	M
13	Ground Level	GL	=	338.234	M

BRIDGE DATA

1	Type of Structure	=	R.C.C. Barrel Type		
2	Angle of Crossing	=	90		Degree
3	Nos. Of Barrel	=	1		Nos.
4	Size of Barrel	=	2	X 1.8	M
5	Formation Level	=	339.200		M
6	Length of Barrel	=	30		M
7	Free Board in Barrel	=	0.8		M

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HYDRAULIC DESIGN :

(1) Suitability of the Structure :

Canal bed level	=	338.749 m
FSL of canal	=	339.749 m
Formation Level	=	339.200 m

Hence a canal syphon is proposed.

(2) Canal waterway and size of pipes :

Discharge	=	3.187 Cumecs			
Max. velocity from Barrel	=	4.0 m/sec			
Area required	=	0.797 Sqm			
Providing RCC Barrel Size Of	=	2.00	x	1.80	
Haunch size	=	0.20	x	0.20	M
Thickness of Barrel	=	0.30	M		
Open Area of one Barrel is	=	2x1.8- 4 x (1/2x 0.2x0.2)			
	=	3.58			
No.s Of Barrel Provided	=	1			
Actual area of waterway	=	3.580 Sqm			
Total wetted perimeter	=	7.120 m			
Hydraulic mean radius R	=	0.503 m			
Actual Velocity	=	0.89 m/sec			
	<	3.00 m/sec			

$$\text{Velocity} = \frac{1}{n} \times R^{2/3} \times S^{1/2}$$

$$0.89 = \frac{0.632 \times S^{1/2}}{0.018}$$

S	=	0.00064
S	=	1 in 1556.9
Say	=	1 in 1550
Top level of barrel at centre	=	339.100 m
Say	=	339.100 m

Top level of barrel at centre = Top of barrel - Thickness of Barrel - Depth of Barrel

= 339.100 - 0.300 - 1.800

= 337.000 m

Total length of Structure = 30.00 m

(E) **Calculation For Losses**

Head Loss Calculation :-

(I) By unwins formula , $Hf = \frac{(1+f_1+f_2*L/R)V^2}{2g}$ =

where f1= 0.505 & f2 = a(1+b/R)

where a & b are as follows (Para 5.11 of E-In-C70/1 Publication)

For concrete surface a = 0.00316 and b = 0.03

area of one Barrel = 3.58 Sq Mts

perimeter of barrel = 7.120 Mts

R = A/P = 0.503 M

f2 = 0.00316(1 + 0.03/0.503) = 0.0033

L = Length of barrel

= 30.00

& hence Hf = $1 + 0.505+0.0033 \times (30/0.503) \times \frac{0.89}{2 \times 9.81}$

= 0.070 m

D/S C.B.L. OF CANAL = C.B.L. - HEAD LOSS

= 356.204 - 0.070

= 356.134 M

Hence there is Head Loss provison in Canal

U/S Invert level of Barrel = Invert level of Barrel at centre + Drop in Barrel

= 337.000 + 0.010

= 337.010 m

Hence U/S Invert level of barrel = 337.010 m

HENCE THE U/s CBL as per L-sec = 338.749 M

D/S Invert level of Barrel = Invert level of Barrel at centre - Drop in Barrel

= 337.000 - 0.010

= 336.990 m

Hence D/S Invert level of barrel = 336.990 m

HENCE THE D/s CBL as per L-sec = 338.649 M

(3) Scour depth calculation :

Q = 3.19 Cumecs

The normal scour depth D = $0.473 (Q/f)^{1/3}$ Here, f = 1.75

= 0.578 m below H.F.L.

Regime scour depth D_r = $D (W/L)^{0.61}$

Where, W = 4.83 √Q = 4.83 x √ 3.19

= 8.62 m

& L at entry = 7.28 m

D_r = $0.578 \times \left(\frac{8.62}{7.28}\right)^{0.61}$

= 0.640 m

Max. scour depth D_{m1} = $1.5 \times D_r$

= 1.500 x 0.640

= 0.961 m

Max. scour level = 339.749 - 0.961

= 338.788 m .....(I)

Foundation level of Wingwall = 335.510 m .....(II)

Foundation is kept at minimum of (I), (II) = 335.510 m

DESIG OF NOTCH: Providing Trapezoidal type notch

Notch Width = 0.224 X Q X(WATER DEPTH) $^{-3/2}$

= 0.221 x 112.53 x 3.30 $^{-3/2}$

= 4.15 feet

= 1.27 m

say = 1.35 m

:h of Notch = Bottom width of notch + 2d' TAN α

= 4.43 +2 x 3.30 X M Q d' $^{-5/2}$

= 4.43 +2 x 3.30 x 0.055 x 112.5 x x 3.30 $^{-5/2}$

= 6.50 feet

= 1.98 m

= 2 m

pitching in outer slope of canal is to be provided.

charge through no = 4.46 X notch width x FSD $^{1.5}$

= 4.46 x 4.43 x 3.30 $^{1.5}$

= 3.352 cumecs

> 3.187 cumecs

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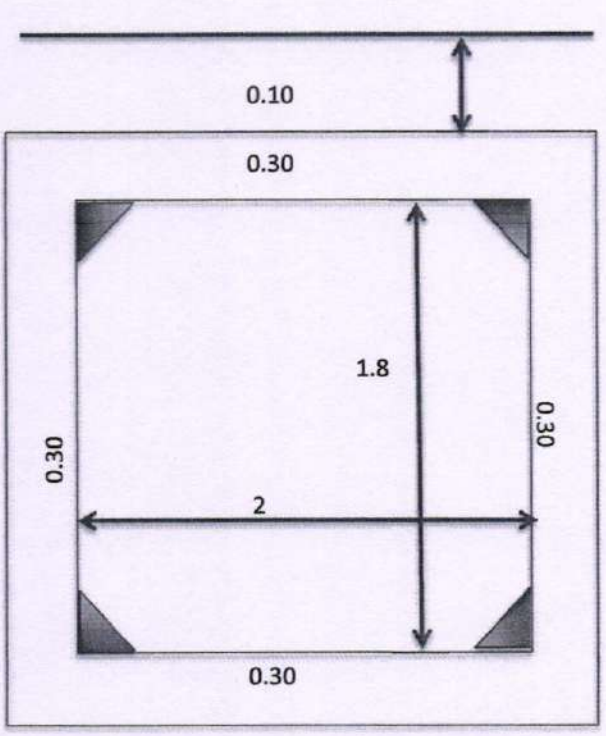
RCC BOX CULVERT , DESIGNATION

SAILENT FEATURES

1	BOX SIZE	2.00 X 1.80
2	TOP SLAB THICKNESS	0.30 M
3	BOTTOM SLAB THICKNESS	0.30 M
4	SIDE WALL THICKNESS	0.30 M
5	UNIT WEIGHT OF CONCRETE	24 KN/m3
6	UNIT WEIGHT OF EARTH	18 KN/m3
7	UNIT WEIGHT OF WATER	10 KN/m3
8	COEFFICIENT OF EARTH PRESSURE	0.5
9	TOTAL CUSHION ON TOP	5.0 M
10	THICKNESS OF WEARING COAT	0.07 M
11	CARRIAGEWAY	8 LANE DIVIDED
12	CONCRETE GRADE	M25 = 25 MPA
13	STEEL GRADE	FE415 = 415 MPA
14	σSC	8.33 MPA
15	σST	230 MPA
16	n (FOR DEPTH OF NEUTRAL AXIS)	0.294
17	k (FOR MOMENT OF RESISTANCE)	1.105 MPA
18	j (FOR EFFECTIVE DEPTH)	0.902
19	No of Barrel	1



CROSS SECTION OF BOX(IN M)

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LOAD CALCULATION

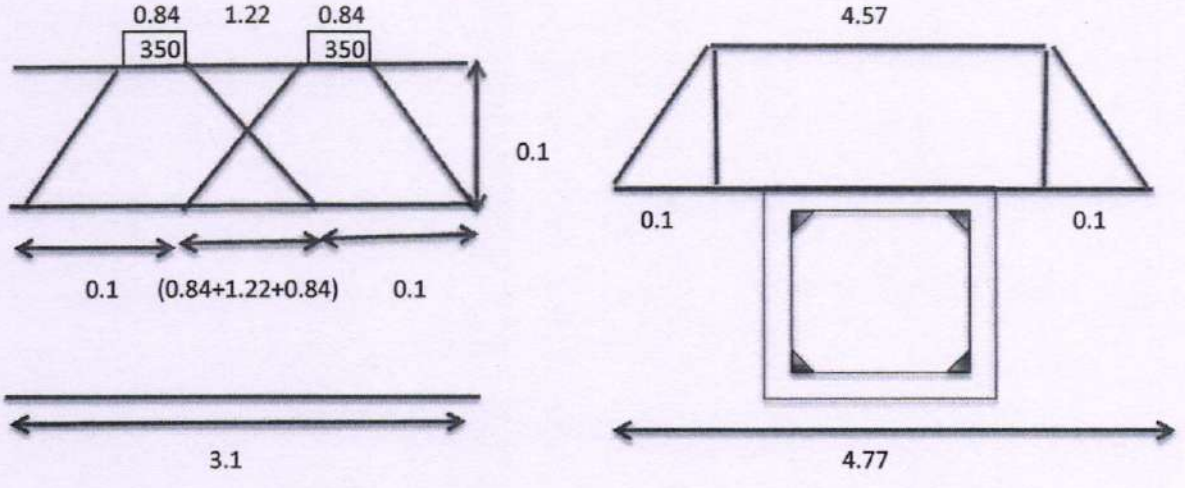
2.1 TOP SLAB

2.1.1 DEAD LOAD

a	cushion	=	0.1	x	18	=	1.8	kn/m3
b	self wt. of top slab =		0.30	x	24	=	7.2	kn/m3
c.	TOTAL					=	9	kn/m3

2.1.2 LIVE LOAD

consider moving load of 70R (T). The dispersal and position of load shall be as under:



Disperseal perpendicular to span = 0.84 + 2 x 0.10 = 1.040 kM/m2

Dispersal in span diirection

4.57+2t + 2d = 4.57+0.2 = 4.77 kN/m2

Note :

1 Since the length of wheel is more than total width of box at top that is 3.84 m further dispersal by "2d" shall not be possible, hence not taken. In case where the length of load is less than the width of box but works out more when
2 As the load of wheel after dispersal does not overlap, both wheels need to be taken separately.
3 For dispersal refer IRC:21-2000 Clause305.16.3.
4 Impact as per IRC:6-2000 Clause 211 shall betaken.
5 This shall be the load when α is zero and live loadis taken to disperse through wearing coat only.
loads per unit area when 2 track load (covering 4- lanes) is considered

= 350/4.77 x 1.04 = 70.55 kN/m2

Impact factor for 70R(T) shall be br 25% as per clause 211.3(a)(i) of IRC:6-2000

Loading Includind impact 88.19 kN/m2

The larger of the two that is 88.2 kN/m2 is considered

Note:

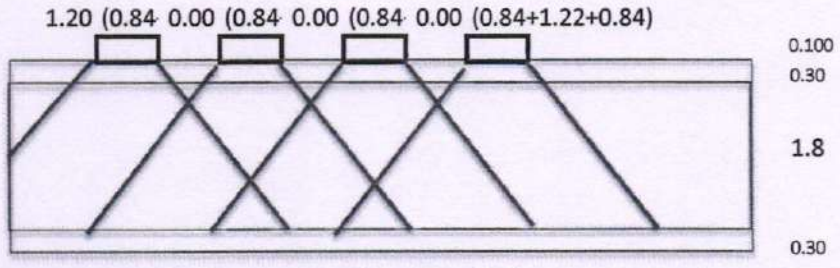
1) As the load of Wheel after disposal over lap both wheels need to be taken together.
2) For the dispersal refer IRC:21-2000 Clause 305.16.4.
3) impact as per IRC-6-2014 Clause 208.6.7(c) due to cushion more than 3.0 m.

2.1.3 Total load (D.L. +L.L.) = 97.19 kN/m2

2.2 **Bottom Slab**

2.2.1 Dead load

Load from the top slab including cushion	=	9	kN/m2
Load of walls = (2x1.8x0.3x24) /2.6	=	9.97	kN/m2
self wt. of Bottom slab = 0.30 x 24	=	7.2	kN/m2
Total Load	=	26.17	kN/m2



The live Load on top box will be disperse through walls and when arranged on the carriage way (length wise of the box) the distribution shall be as under:

Taking reductiom for simultaneous addition lane loadings at 20% (refer IRC:6-2000,clause 208), the load on unit area of bottom salb for two track loading works out to 20.51KN/M2, if one track without reduction is considereed restricting area as dispersal the laod per unit area works out 19.8kN/m2.The dispersed live load on bottom slab can be taken to be 21kN/m2.

Total load = 26.2 + 21 = 47.17 kN/m2

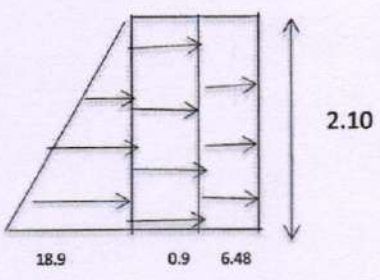
Live Load

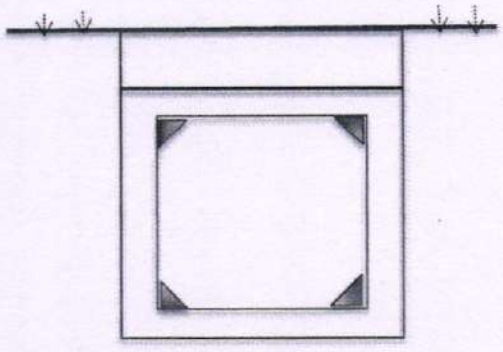
Load from top slab with impact	=	88.19	kN/m2

Total load = 26.2 + 88 = 114.36 kN/m2

2.3 Side Wall

2.3.1 case 1 : Box empty , earth pressure with live load surcharge equivalent to 0.72 m ht. of earth on both sides fills.





Pressure due to live load Surcharge

= 0.72 x 18 x 0.5 = 6.48 kN/m2

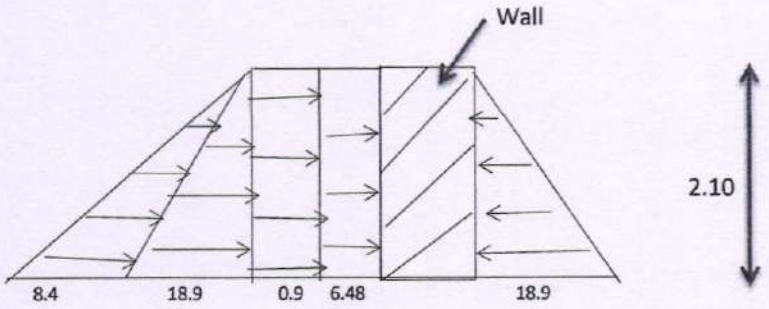
Pressure due to Earth Surcharge

= 0.1 x 18 x 0.5 = 0.9 kN/m2

Pressure due to Earth Fill

= 2.1 x 18 x 0.5 = 18.9 kN/m2

Case 2 : Box full .Live Load Surcharge on side fill



Pressure due to live load Surcharge

= 6.48 = 6.48 kN/m2

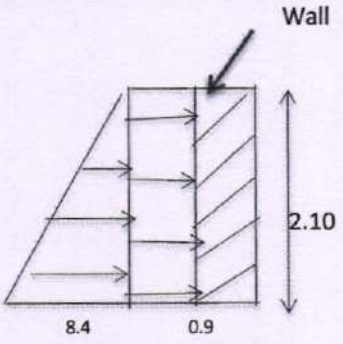
Pressure due to Earth Surcharge

= 0.9 = 0.9 kN/m2

Pressure due to Earth Fill

= 0.5 x (18-10) x 2.1 = 8.4 kN/m2

2.3.2 case 3 : Box Full , no live Load surcharge on side fill



Pressure due to Submerged Earth

= 8.4 = 8.4 kN/m2

Pressure due to Earth Surcharge

= 0.9 = 0.9 kN/m2

2.4 **Base Presssure**

DEAD LOAD

Load from top slab and walls including cushion

= 26.17 kN/m2

Self weight of bottom slab

= 0.3x24 = 7.2 kN/m2

Total Load = 33.37 kN/m2

Live Load

There is no live load except coming from top slab

withimpact = 88.19 kN/m2

2.4.1 Base Presssure = 121.56 kN/m2

(Is safe for a S.B.C of 150 kN/m²)

3 MOMENT CALCULATION

3.1 TOP SLAB

Fixed end moment due to dead load	=	9x2.3x2.3/12	=	3.97	
Fixed end moment due to live load	=	13.81x2.3x2.3/12	=	6.09	
Total fixed end moment			=	10.06	kN.M
mid span moment due to dead load	=	9x2.3x2.3/8	=	5.95	
mid span moment due to live load	=	13.81x2.3x2.3/8	=	9.13	
Total mid span moment			=	15.08	

3.2 BOTTOM SLAB

Fixed end moment due to dead load	=	26.17x2.3x2.3/12	=	11.54	
Fixed end moment due to live load	=		=	6.09	
Total fixed end moment			=	17.63	kN.M
mid span moment due to dead load	=	26.17x2.3x2.3/8	=	17.3	
mid span moment due to live load	=		=	9.13	
Total mid span moment			=	26.43	kN.M

3.3 SIDE WALL

3.3.1 case-1 Box empty , surcharge load on side fill Fem at top due to dead load

Fem at top due to dead load

$$= \frac{0.9x2.1x2.1}{12} + \frac{18.9x2.1x2.1}{30} = 3.11$$

FEM at top due to live load

= 6.48x2.1x2.1/12 = 2.38

Total FEM at top = 5.49 kN.M

FEM at bas due to dead load

$$= \frac{0.9x2.1x2.1}{12} + \frac{18.9x2.1x2.1}{20} = 4.5 \text{ kN.M}$$

FEM at bas due to live load = 2.38

Total FEM at base = 6.88 kN.M

Mid Span moment due to dead load

$$= \frac{0.9x2.1x2.1}{8} + \frac{18.9x2.1x2.1}{16} = 5.71$$

Mid Span moment due to live load

= 6.48x2.1x2.1/8 = 3.57

Total mid span moment = 9.28 kN.M

3.3.1 case-2 Box full ,live load surcharge on side fill

Fem at top due to dead load

$$= \frac{0.9x2.1x2.1}{12} + \frac{8.4x2.1x2.1}{30} = 1.56$$

FEM at top due to live load

= 6.48x2.1x2.1/12 = 2.38

Total FEM at top = 3.94 kN.M

FEM at bas due to Dead load

$= \frac{0.9x2.1x2.1}{12} + \frac{8.4x2.1x2.1}{20}$ = 2.18 kN.M

FEM at bas due to live load = 2.38

Total FEM at base = 4.56 kN.M

Mid Span moment due to dead load

$= \frac{0.9x2.1x2.1}{8} + \frac{8.4x2.1x2.1}{16}$ = 2.82

Mid Span moment due to live load

= 6.48x2.1x2.1/8 = 3.57

Total mid span moment = 6.39 kN.M

3.3.1 case-3 Box full ,no live load surcharge

Fem at top due to dead load

$= \frac{0.9x2.1x2.1}{12} + \frac{8.4x2.1x2.1}{30}$ = 1.56

FEM at top due to live load = 0

Total FEM at top = 1.56 kN.M

FEM at bas due to Dead load

$= \frac{0.9x2.1x2.1}{12} + \frac{8.4x2.1x2.1}{20}$ = 2.18 kN.M

FEM at bas due to live load = 0

Total FEM at base = 2.18 kN.M

Mid Span moment due to dead load

$= \frac{0.9x2.1x2.1}{8} + \frac{8.4x2.1x2.1}{16}$ = 2.82

Mid Span moment due to live load

= = 0

Total mid span moment = 2.82 kN.M

4 DISTRIBUTION FACTORS

Junction	MEMBERS	$4EI/L=Kd^3/L$	modified I 2	SUM 4EI/L	Distribution factors
A	AB	1/2.3	0.435	0.435/0.911	0.480
	AD	1/2.1	0.476	0.476/0.911	0.520
B	BC	1/2.1	0.476	0.476/0.911	0.520
	BA	1/2.3	0.435	0.435/0.911	0.480
C	CD	1/2.3	0.435	0.435/0.911	0.480
	CB	1/2.1	0.476	0.476/0.911	0.520
D	DA	1/2.1	0.476	0.476/0.911	0.520
	DC	1/2.3	0.435	0.435/0.911	0.480

5 MOMENT DISTRIBUTION

5.1 F.E.M. Due to dead load

M_{AB} = 3.97

M_{BA} = -3.97

M_{CD} = 11.54

M_{DC} = -11.54

		CASE 1	CASE 2	CASE 3
M_{AD} =	M_{BC} =	3.11	1.56	1.56
M_{DA} =	M_{CB} =	4.5	2.18	2.18

5.2 F.E.M. Due to live load

M_{AB} = 6.09

M_{BA} = -6.09

M_{CD} = 6.09

M_{DC} = -6.09

		CASE 1	CASE 2	CASE 3
M_{AD} =	M_{BC} =	2.38	2.38	0
M_{DA} =	M_{CB} =	2.38	2.38	0

5.3 F.E.M. Due to total load

M_{AB} = 10.06

M_{BA} = -10.06

M_{CD} = 17.63

M_{DC} = -17.63

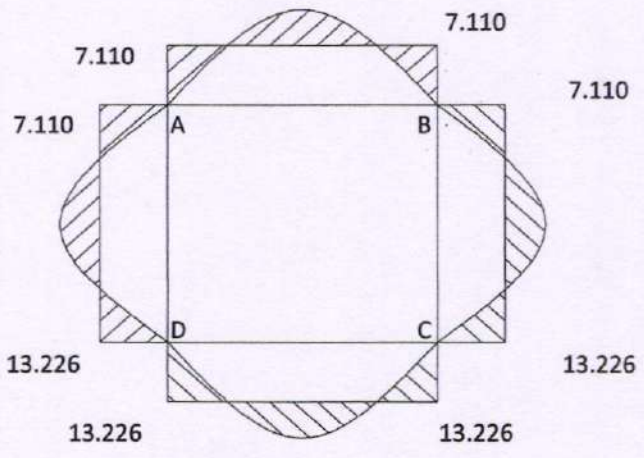
		CASE 1	CASE 2	CASE 3
M_{AD} =	M_{BC} =	5.49	3.94	1.56
M_{DA} =	M_{CB} =	6.88	4.56	2.18

5.4 A typical distribution is shown in table .results based o similaar distribution for other combination are given in other table

CASE 1 :

JOINT	A		B		C		DC	
MEMBER	AD	AB	BA	BC	CB	CD	DC	DA
D.F.	0.520	0.480	0.480	0.520	0.520	0.480	0.480	0.520
MOMENT	-5.490	10.060	-10.060	5.490	-6.880	17.630	-17.630	6.880
BALANCE	-2.376	-2.194	2.194	2.376	-5.590	-5.160	5.160	5.590
C.O.	2.795	1.097	-1.097	-2.795	1.188	2.580	-2.580	-1.188
BALANCE	-2.024	-1.868	1.868	2.024	-1.959	-1.809	1.809	1.959
C.O.	0.980	0.934	-0.934	-0.980	1.012	0.905	-0.905	-1.012
BALANCE	-0.995	-0.919	0.919	0.995	-0.997	-0.920	0.920	0.997
C.O.	0.499	0.460	-0.460	-0.499	0.498	0.460	-0.460	-0.498
BALANCE	-0.499	-0.460	0.460	0.499	-0.498	-0.460	0.460	0.498
C.O.	0.249	0.230	-0.230	-0.249	0.250	0.230	-0.230	-0.250
BALANCE	-0.249	-0.230	0.230	0.249	-0.250	-0.230	0.230	0.250
C.O.	0.125	0.115	-0.115	-0.125	0.125	0.115	-0.115	-0.125
BALANCE	-0.125	-0.115	0.115	0.125	-0.125	-0.115	0.115	0.125
C.O.	0.063	0.058	-0.058	-0.063	0.063	0.058	-0.058	-0.063
BALANCE	-0.063	-0.058	0.058	0.063	-0.063	-0.058	0.058	0.063

C.O.	0.032	0.029	-0.029	-0.032	0.032	0.029	-0.029	-0.032
BALANCE	-0.032	-0.029	0.029	0.032	-0.032	-0.029	0.029	0.032
C.O.	0.016	0.015	-0.015	-0.016	0.016	0.015	-0.015	-0.016
BALANCE	-0.016	-0.015	0.015	0.016	-0.016	-0.015	0.015	0.016
C.O.	0.008	0.008	-0.008	-0.008	0.008	0.008	-0.008	-0.008
BALANCE	-0.008	-0.008	0.008	0.008	-0.008	-0.008	0.008	0.008
C.O.	0.004	0.004	-0.004	-0.004	0.004	0.004	-0.004	-0.004
BALANCE	-0.004	-0.004	0.004	0.004	-0.004	-0.004	0.004	0.004
C.O.	0.002	0.002	-0.002	-0.002	0.002	0.002	-0.002	-0.002
BALANCE	-0.002	-0.002	0.002	0.002	-0.002	-0.002	0.002	0.002
C.O.	0.001	0.001	-0.001	-0.001	0.001	0.001	-0.001	-0.001
BALANCE	-0.001	-0.001	0.001	0.001	-0.001	-0.001	0.001	0.001
C.O.	0.001	0.001	-0.001	-0.001	0.001	0.001	-0.001	-0.001
BALANCE	-0.001	-0.001	0.001	0.001	-0.001	-0.001	0.001	0.001
TOTAL	-7.110	7.110	-7.110	7.110	-13.226	13.226	-13.226	13.226

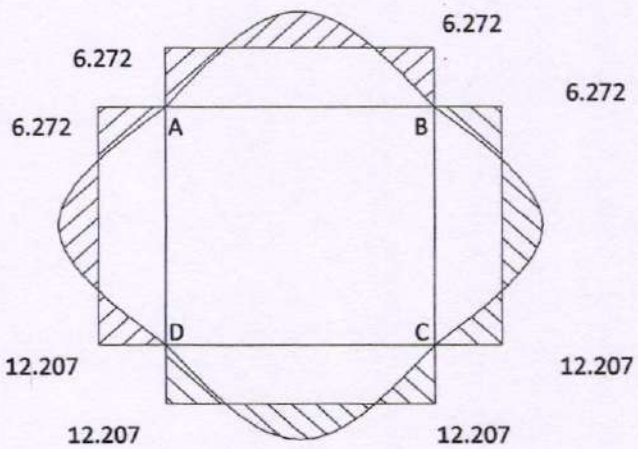


NET MOMENT DIAGRAM

CASE 2 :

JOINT	A		B		C		DC	
MEMBER	AD	AB	BA	BC	CB	CD	DC	DA
D.F.	0.520	0.480	0.480	0.520	0.520	0.480	0.480	0.520
MOMENT	-3.940	10.060	-10.060	3.940	-4.560	17.630	-17.630	4.560
BALANCE	-3.182	-2.938	2.938	3.182	-6.796	-6.274	6.274	6.796
C.O.	3.398	1.469	-1.469	-3.398	1.591	3.137	-3.137	-1.591
BALANCE	-2.531	-2.336	2.336	2.531	-2.459	-2.269	2.269	2.459
C.O.	1.230	1.168	-1.168	-1.230	1.266	1.135	-1.135	-1.266
BALANCE	-1.247	-1.151	1.151	1.247	-1.249	-1.152	1.152	1.249
C.O.	0.625	0.576	-0.576	-0.625	0.624	0.576	-0.576	-0.624
BALANCE	-0.625	-0.576	0.576	0.625	-0.624	-0.576	0.576	0.624
C.O.	0.312	0.288	-0.288	-0.312	0.313	0.288	-0.288	-0.313
BALANCE	-0.312	-0.288	0.288	0.312	-0.313	-0.288	0.288	0.313
C.O.	0.157	0.144	-0.144	-0.157	0.156	0.144	-0.144	-0.156
BALANCE	-0.157	-0.144	0.144	0.157	-0.156	-0.144	0.144	0.156

C.O.	0.078	0.072	-0.072	-0.078	0.079	0.072	-0.072	-0.079
BALANCE	-0.078	-0.072	0.072	0.078	-0.079	-0.072	0.072	0.079
C.O.	0.040	0.036	-0.036	-0.040	0.039	0.036	-0.036	-0.039
BALANCE	-0.040	-0.036	0.036	0.040	-0.039	-0.036	0.036	0.039
C.O.	0.020	0.018	-0.018	-0.020	0.020	0.018	-0.018	-0.020
BALANCE	-0.020	-0.018	0.018	0.020	-0.020	-0.018	0.018	0.020
C.O.	0.010	0.009	-0.009	-0.010	0.010	0.009	-0.009	-0.010
BALANCE	-0.010	-0.009	0.009	0.010	-0.010	-0.009	0.009	0.010
C.O.	0.005	0.005	-0.005	-0.005	0.005	0.005	-0.005	-0.005
BALANCE	-0.005	-0.005	0.005	0.005	-0.005	-0.005	0.005	0.005
C.O.	0.003	0.003	-0.003	-0.003	0.003	0.003	-0.003	-0.003
BALANCE	-0.003	-0.003	0.003	0.003	-0.003	-0.003	0.003	0.003
C.O.	0.002	0.002	-0.002	-0.002	0.002	0.002	-0.002	-0.002
BALANCE	-0.002	-0.002	0.002	0.002	-0.002	-0.002	0.002	0.002
C.O.	0.001	0.001	-0.001	-0.001	0.001	0.001	-0.001	-0.001
BALANCE	-0.001	-0.001	0.001	0.001	-0.001	-0.001	0.001	0.001
TOTAL	-6.272	6.272	-6.272	6.272	-12.207	12.207	-12.207	12.207

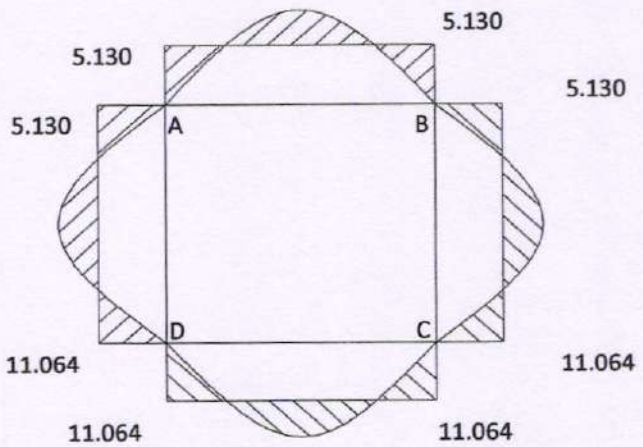


NET MOMENT DIAGRAM

CASE 3 :

JOINT	A		B		C		DC	
MEMBER	AD	AB	BA	BC	CB	CD	DC	DA
D.F.	0.520	0.480	0.480	0.520	0.520	0.480	0.480	0.520
MOMENT	-1.560	10.060	-10.060	1.560	-2.180	17.630	-17.630	2.180
BALANCE	-4.420	-4.080	4.080	4.420	-8.034	-7.416	7.416	8.034
C.O.	4.017	2.040	-2.040	-4.017	2.210	3.708	-3.708	-2.210
BALANCE	-3.150	-2.907	2.907	3.150	-3.077	-2.841	2.841	3.077
C.O.	1.539	1.454	-1.454	-1.539	1.575	1.421	-1.421	-1.575
BALANCE	-1.556	-1.437	1.437	1.556	-1.558	-1.438	1.438	1.558
C.O.	0.779	0.719	-0.719	-0.779	0.778	0.719	-0.719	-0.778
BALANCE	-0.779	-0.719	0.719	0.779	-0.778	-0.719	0.719	0.778
C.O.	0.389	0.360	-0.360	-0.389	0.390	0.360	-0.360	-0.390
BALANCE	-0.389	-0.360	0.360	0.389	-0.390	-0.360	0.360	0.390

C.O.	0.195	0.180	-0.180	-0.195	0.195	0.180	-0.180	-0.195
BALANCE	-0.195	-0.180	0.180	0.195	-0.195	-0.180	0.180	0.195
C.O.	0.098	0.090	-0.090	-0.098	0.098	0.090	-0.090	-0.098
BALANCE	-0.098	-0.090	0.090	0.098	-0.098	-0.090	0.090	0.098
C.O.	0.049	0.045	-0.045	-0.049	0.049	0.045	-0.045	-0.049
BALANCE	-0.049	-0.045	0.045	0.049	-0.049	-0.045	0.045	0.049
C.O.	0.025	0.023	-0.023	-0.025	0.025	0.023	-0.023	-0.025
BALANCE	-0.025	-0.023	0.023	0.025	-0.025	-0.023	0.023	0.025
C.O.	0.013	0.012	-0.012	-0.013	0.013	0.012	-0.012	-0.013
BALANCE	-0.013	-0.012	0.012	0.013	-0.013	-0.012	0.012	0.013
C.O.	0.007	0.006	-0.006	-0.007	0.007	0.006	-0.006	-0.007
BALANCE	-0.007	-0.006	0.006	0.007	-0.007	-0.006	0.006	0.007
C.O.	0.004	0.003	-0.003	-0.004	0.004	0.003	-0.003	-0.004
BALANCE	-0.004	-0.003	0.003	0.004	-0.004	-0.003	0.003	0.004
C.O.	0.002	0.002	-0.002	-0.002	0.002	0.002	-0.002	-0.002
BALANCE	-0.002	-0.002	0.002	0.002	-0.002	-0.002	0.002	0.002
C.O.	0.001	0.001	-0.001	-0.001	0.001	0.001	-0.001	-0.001
BALANCE	-0.001	-0.001	0.001	0.001	-0.001	-0.001	0.001	0.001
TOTAL	-5.130	5.130	-5.130	5.130	-11.064	11.064	-11.064	11.064



NET MOMENT DIAGRAM

LOAD	CASE	Distributed Moments at Supports				Remarks
		M_{AB}	M_{DC}	M_{AD}	M_{DA}	
		M_{BA}	M_{CD}	M_{BC}	M_{CB}	Load on top slab and bottom slab remains same in all cases, only load on side wall varies. No braking force need be considered due to cushion.
TOTAL LOAD	1	7.110	-13.226	-7.110	13.226	
	2	6.272	-12.207	-6.272	12.207	
	3	5.130	-11.064	-5.130	11.064	
MAX.		7.110	13.226	7.110	13.226	

MID SPAN MOMENTS (TOTAL LOADS ONLY)

MEMBER	CASE 1	CASE 2	CASE 3	REMARKS
M_{AB}	15.08-(7.11+7.11)/2	15.08-(6.272+6.272)/2	15.08-(5.13+5.13)/2	The walls bends outwardly in all threee cases
	7.97	8.808	9.95	
M_{CD}	26.43-(13.226+13.226)/2	26.43-(12.207+12.207)/2	26.43-(11.064+11.064)/2	
	13.204	14.223	15.366	
M_{AD}	9.28-(7.11+13.226)/2)	6.39-(6.272+12.207)/2)	2.82-(5.13+11.064)/2)	
	-0.888	-2.850	-5.277	

6 BRAKING FORCE

6.1 LOAD:70R(T), wheel load is considered as there is no overlapping

The braking ofrce shall be 20% for the first lane load

The brakig force = 350X 20/100 = 70 kN

Load on top box which will affect the box

= 2.60 x 70/4.77 = 38.16 kN

6.2 Moment due to braking force

$M_{AB} = M_{CD}$ = 38.16x4.77/2

= 91.01 kN

The moments at top and bottom end sahll be zero

After distribution of moment among all the member a moment of 46 kN.m is obtained at all end

This moment is added to the maximum moments obtained for varius combination of loadings at the ends of members to get design moments. Since braking force can also act from the reverse direction the moment at junctions are added irrespective of its sign

7 DESIGN OF SECTION

7.1 Design moemnts

				MID-SPAN		
Load	Case	M_{AB}	M_{dc}	AB	DC	AD
Total Load	Maximum of All cases	7.110	13.226	9.95	15.366	-0.888
Braking Force	Distributed Moments at support	45.510	45.510	0	0	0
Design	Support Moments Including braking	52.620	58.736	9.950	15.366	-0.888

7.2 Top Slab

Design of Top slab under Max. sagging (+ve) B.M.

Maximum moment AT mid span including braking = 9.950 kN.m

Depth required = $\sqrt{\frac{9.95 \times 10^6}{1000 \times 1.105}}$ = 94.89 mm

provide 260 mm is SAFE

Ast = M / tjd = $\frac{9.950 \times 10^6}{230 \times 0.902 \times 260}$ = 184.47 mm^2

Thickness of top slab provided = 0.300

Clear cover provided = 0.040

1 Diameter of the reinforcement st bars = 12 mm

2 Diameter of the reinforcement Cranck bars = 16 mm

Effective depth provided using mm cover and mm dia bars

= 0.254

Providing 12 mm dia bars at a spacing of 300 mm 376.8 mm^2

Providing 16 mm dia bars at a spacing of 300 mm 669.87 mm^2

There fore area of steel provided = 1046.67 mm^2

HENCE SAFE

There fore provide sagging reinforcement of 12 mm dia bars at 300 mm c/c spacing

Design of Top slab under Max. hogging (-ve) B.M.

Maximum moment AT support n including braking = 52.620 kN.m

Depth required = $\sqrt{\frac{52.620 \times 10^6}{1000 \times 1.105}}$ = 218.22 mm

provide 260 mm is SAFE

As per Cl. No. 305.5 of IRC 21: 2000, when the haunches are provided the total depth of slab or beam may be considered as depth of slab or beam assumed initially + size of haunches divided by 3.

In this case initial depth of slab assumed = 0.30 m

Size of Haunches = 0.20 x 0.2

Effective depth provided (when no haunches) = 0.254 m

There fore the depth of slab when the haunches are provided = 0.3 + 0.2/3

= 0.37 m

Clear cover provided = 0.04 m

Diameter of the reinforcement (sagging bar) = 12 MM

Effective depth provided using 40 mm cover and 12 mm bars (when haunches provided)

= 0.37 - 0.04 - 0.006

= 0.324 m

HENCE SAFE

Area of steel required = M / σst j d

Ast = M / tjd = $\frac{52.620 \times 10^6}{230 \times 0.902 \times 260}$ = 975.54 mm^2

Sagging steel are crancked on to supports

= 669.87 mm^2

Balane area of steel to be provided = 975.54 - 669.87

= 305.67 mm^2

Diameter of straight bar = 12 mm

Providing mm dia straight bars at a spacing of = 300 mm

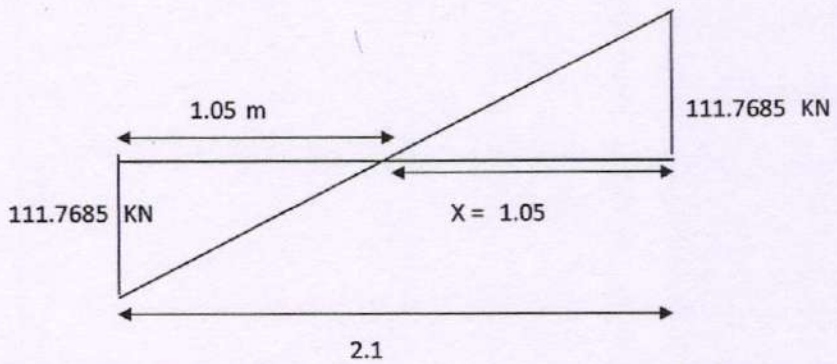
Ast. Provided by **straight** bars = 376.8 mm^2

Total area of steel provided = 669.87 + +376.8

= 1046.67 mm^2

HENCE SAFE

There fore area of steel provided at supports:
Crancked bars of 12 mm dia at a spacing of 600 mm c/c
Straight bars of 12 mm dia at a spacing of 300 mm c/c
Max. shear force intensities at the supports are as shown on diagram



Max. Shear force of above case = 111.7685 KN
Corrosponding distance 'X' from where it changes its sign (i.e. + or -) to Max. S.F.
= 1.05 M
Shear force at a distance of effective depth 'd' + half of the thickness of support from centre line of the support
= 0.3 + 0.3/2
= 0.45 M
There fore the Maximum shear force at a distance of 0.45 m from the centre line of the support are
= 111.7685 x (1.05 - 0.45) / 1.05
Max. Total shear force = 63.87 KN
Nominal shear stress = V / bd
= 63.8677142857143/(1000 X254)
= 0.25 N/mm^2
% of tension steel provided at supports = 100 Ast. / bd
= 100 x 1046.67 / 1000 x 254
= 0.412 %
Corroesponding permisible shear stress Tc from Table 23 of IS 456:2000
= 0.272 N/mm^2
Since the Permisible shear stress Tc is more than the Nominal shear stress Tv, Shear reinforcement is not needed, and the section is need not design from SHEAR criteria, Hence the section is to be designed from hogging (-ve) B.M.
Shear resisted by concrete Vc = Tc b d
= 0.412 x 1000 x 254
= 104648 N
= 105 KN
Shear resisted by bent up bars = 669.87 x 230 x 0.707
= 108928 N
109 KN
Total shear resisted by concrete & bent up bars = 104.65+108.93
= 214 KN
> 64 KN
Since the shear resisted by concrete & bent up bars are more than the required, Design of reinforcement from shear criteria is not needed. HENCE O.K.

8.2 BOTTOM Slab

Design of Bottom slab under Max. sagging (+ve) B.M.

Maximum moment at mid span including braking = 15.366 kN.m

Depth required = $\sqrt{\frac{15.366 \times 10^6}{1000 \times 1.105}}$ = 117.92 mm

provide 260 mm is SAFE

Ast = $\frac{M}{tjd} = \frac{15.366 \times 106}{230 \times 0.902 \times 260}$ = 284.87 mm^3

	Thickness of Bottom slab provided		=	0.300	
	Clear cover provided		=	0.040	
1	Diameter of the reinforcement	st bars	=	12	mm
2	Diameter of the reinforcement	Cranck bars	=	16	mm
			=	0.254	
	Providing 12 mm dia bars at a spacing of	300 mm		376.8	mm^2
2	Providing 16 mm dia bars at a spacing of	300 mm		669.87	mm^2
	There fore area of steel provided		=	1046.67	mm^2

HENCE SAFE

There fore provide sagging reinforcement of 12 mm dia bars at 300 mm c/c spacing

Design of Bottom slab under Max. hogging (-ve) B.M.

Maximum moment at mid span including braking = 58.736 kN.m

Depth required = $\sqrt{\frac{58.736 \times 10^6}{1000 \times 1.105}}$ = 230.55 mm

provide 260 mm is SAFE

As per Cl. No. 305.5 of IRC 21: 2000, when the haunches are provided the total depth of slab or beam may be considered as depth of slab or beam assumed initially + size of haunches divided by 3.

In this case initial depth of slab assumed	=	0.30	m	
Size of Haunches	=	0.20	x	0.2
Effective depth provided (when no haunches)	=	0.254	m	
There fore the depth of slab when the haunches are provided	=	0.3 + 0.2/3		
	=	0.37	m	
Clear cover provided	=	0.04	m	
Diameter of the reinforcement (sagging bar)	=	12	MM	
Effective depth provided using 40 mm cover and 12 mm bars (when haunches provided)				
	=	0.37 - 0.04 - 0.006		
	=	0.324	m	

HENCE SAFE

Area of steel required = M / σst j d

Ast = $\frac{M}{tjd} = \frac{58.736 \times 106}{230 \times 0.902 \times 260}$ = 1088.92 mm^2

Sagging steel are crancked on to supports

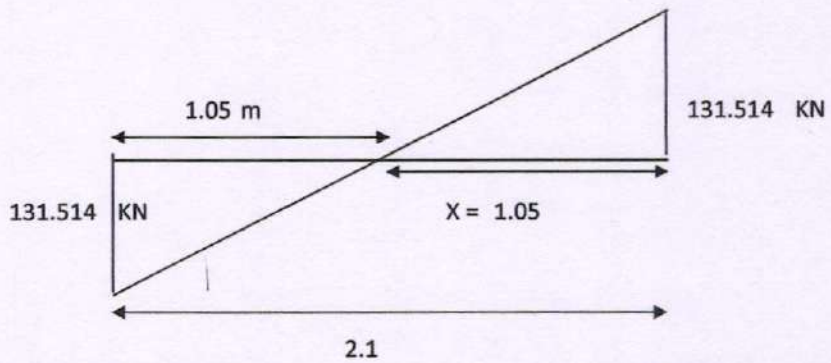
	=	669.87	mm^2
Balane area of steel to be provided	=	1088.92 - 669.87	
	=	419.05	mm^2
Diameter of straight bar	=	12	mm
Providing mm dia straight bars at a spacing of	=	300	mm
Ast. Provided by **straight** bars	=	376.8	mm^2
Total area of steel provided	=	669.87 + +376.8	
	=	1046.67	mm^2
		UNSAFE	

There fore area of steel provided at supports:

Crancked bars of 12 mm dia at a spacing of 600 mm c/c

Straight bars of 12 mm dia at a spacing of 300 mm c/c

Max. shear force intensities at the supports are as shown on diagram



Max. Shear force of above case	=	131.514	KN
Corrosponding distance 'X' from where it changes its sign (i.e. + or -) to Max. S.F.			
	=	1.05	M
Shear force at a distance of effective depth 'd' + half of the thickness of support from centre line of the support			
	=	0.3 + 0.3/2	
	=	0.45	M
There fore the Maximum shear force at a distance of 0.45 m from the centre line of the support are			
	=	131.514 x (1.05 - 0.45) / 1.05	
Max. Total shear force	=	75.15	KN
Nominal shear stress	=	V / bd	
	=	75.1508571428571/(1000 X254)	
	=	0.30	N/mm^3
% of tension steel provided at supports	=	101 Ast. / bd	
	=	100 x 1046.67 / 1000 x 254	
	=	0.412	%
Corroesponding permisible shear stress Tc from Table 23 of IS 456:2001			
	=	0.272	N/mm^2

Since the Permisible shear stress Tc is less than the Nominal shear stress Tv, The design is to be done from SHEAR criteria.

Shear resisted by concrete	Vc	=	Tc b d	
		=	0.412 x 1000 x 254	
		=	104648	N
		=	105	KN
Shear resisted by bent up bars		=	669.87 x 230 x 0.707	

	=	108928	N
		109	KN
Total shear resisted by concrete & bent up bars	=	104.65+108.93	
	=	214	KN
	>	75	KN

Since the shear resisted by concrete & bent up bars are more than the required, Design of reinforcement from shear criteria is not needed. HENCE O.K.

8.2 SIDE WALLS

Maximum moments at junctions of slabs and walls are same as slabs. Hence provide same reinforcements as slabs at junctions/supports.

Design of SIDE WALL under Max. sagging (+ve) B.M.

Maximum moment support/mid span including braking = -0.888 kN.m

Depth required = $\sqrt{\frac{-0.888 \times 10^6}{1000 \times 1.105}}$ = #NUM! mm

provide 260 mm is ####

Ast = $\frac{M}{tjd} = \frac{-0.888 \times 106}{230 \times 0.902 \times 260}$ = -16.46 mm^3

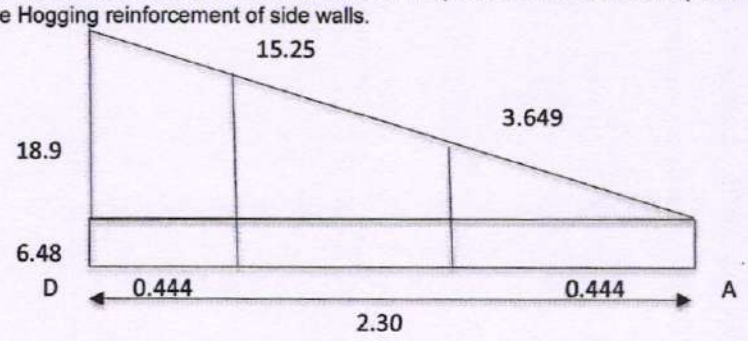
Thickness of Side wall provided	=	0.300	
Clear cover provided	=	0.040	
Diameter of the reinforcement	=	12	mm
Effective depth provided using mm cover and mm dia bars			
	=	0.254	
Providing 12 mm dia bars at a spacing of	300	mm	
There fore area of steel provided	=	376.8	mm^3

HENCE SAFE

There fore provide sagging reinforcement of 12 mm dia bars at 300 mm c/c spacing

There fore provide Hogging reinforcement of 12 mm dia bars at 300 mm c/c spacing

Hence Reinforcement from Cranck Bars from top slab and Bottom slab upto L/4 will be provided to fulfill the requirement of the Hogging reinforcement of side walls.



check for shear

$R_A = \frac{0.9 \times 2.3}{2} + \frac{6.48 \times 2.3}{2} + \frac{(1/2 \times 18.9 \times 2.3)}{3}$

= 1.035 + 7.452 + 7.245

= 15.73 KN

$R_D = \frac{0.9x2.3}{2} + \frac{6.48x2.3}{2} + \frac{(2x1/2x18.9x2.3)}{3}$

1.035 + 7.452 + 14.49

22.98 KN

S.F. near top at Deff from

A= 15.73-0.9x0.444-6.48x0.444-1/2 x3.649x0.444

A= 11.64 KN

S.F. near Base at Deff from

D= 22.98-x0.444-6.48x0.444-(18.9+15.25)/2x0.444

D= 12.52 KN

MAXIMUM SHEAR STRESS = $\frac{12.52X\ 1000}{254X\ 1000}$

= 0.049 N/mm^2

LESS THAN 0.23 N/mm^2 HENCE SAFE FOR 0.25 % STEEL

DISTRIBUTION STEEL :

As per IS Code 3370

MINIMUM REINFORCEMENT TO BE PROVIDED = 0.12% of the cross-sectional area

= 0.12% x 300 x 1000

= 360 mm^2

Diameter of the reinforcement	=	12	mm
Spacing Required	=	314	mm
Spacing Provided	=	300	mm
There fore area of steel provided	=	376.8	mm^2
On both faces of wall	=	753.6	mm^2

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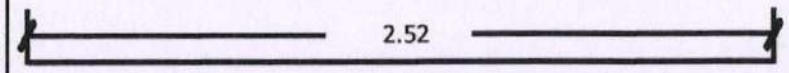
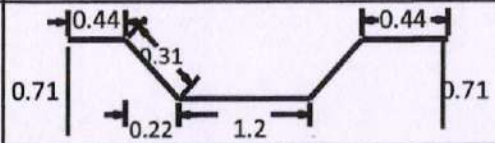
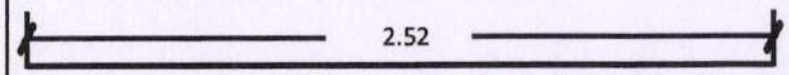
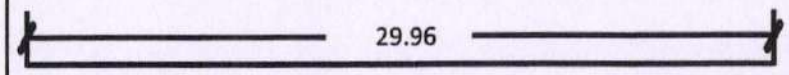
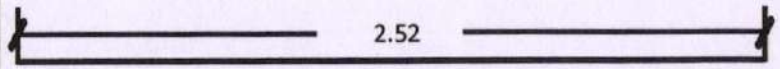
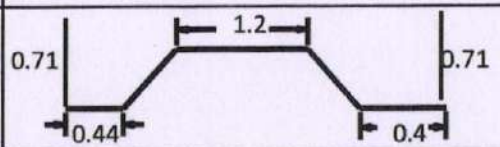
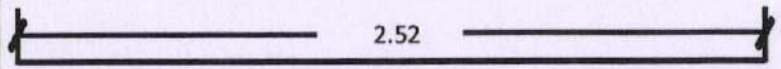
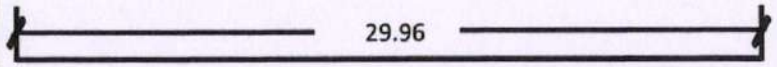
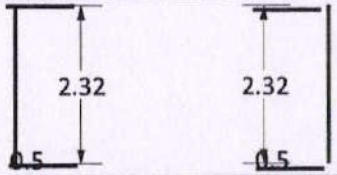
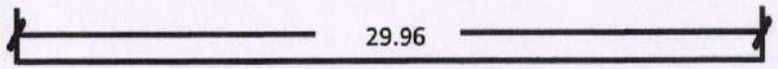
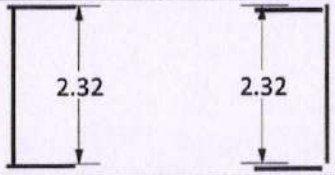
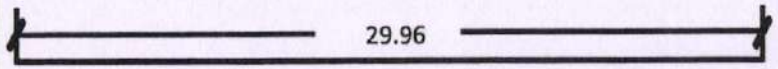
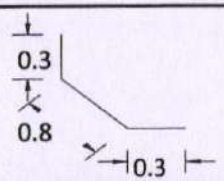
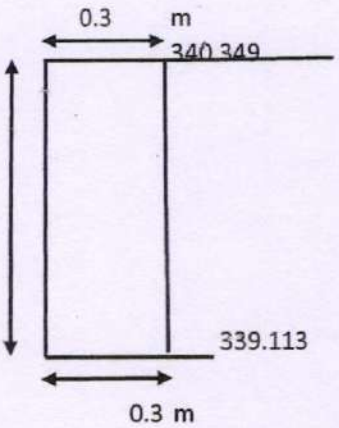
BAR BENDING SCHEDULE FOR BOX CULVERT

Symbol of Bars	Description of bars	Type of Bars	Dia of bars in mm	Spacing of bars in mm	Length of bars in M	Nos of bars	Total Length in M	Unit wt. In kg/m	Qty in kg
TOP SLAB									
A	MAIN BAR ST. BAR(BOTTOM)		12	300	2.52	100	252	0.889	224
B	MAIN BAR BENT UP BOTTOM		16	300	4.12	100	412	1.58	651
C	MAIN BAR ST. BAR(TOP)		12	300	2.52	100	252	0.889	224
D	DISTRIBUTION		12	300	29.96	2 x9	539.3	0.889	479
BOTTOM SLAB									
E	MAIN BAR ST. BAR(TOP)		12	300	2.52	100	252	0.889	224
F	MAIN BAR BENT UP TOP		16	300	4.12	100	412	1.58	651
G	MAIN BAR ST. BAR(BOTTOM)		12	300	2.52	100	252	0.889	224

H	DISTRIBUTION		12	300	29.96	2 x9	539.3	0.889	479
VERTICAL WALL									
I	Away water Face		12	300	3.32	2 x100	664	0.889	590
J	U/S		12	300	29.96	2 x8	479.4	0.889	426
K	WATER SIDE &INTERMEDIATE WALLS		12	300	3.32	2 x100	664	0.889	590
L	DISTRIBUTION		12	300	29.96	2 x8	479.4	0.889	426
M	HAUNCH BARS		10	300	1.4	4 x100	560	0.617	346
TOTAL									5534KG
ADD 5 % FO WAISTAGE AND OVELAPPING									277KG
GRAND TOTAL									5811KG

U/S BREAST WALL :



Earth pressure is acting at a slope of 2:1

ϕ = 30°

Angle of Slope = 26° 34'

δ = 26.56°

$\cos(\phi)$ = 0.866

$\cos(\delta)$ = 0.894

$$K_{ah} = \frac{\cos(\delta)\,[\cos(\delta) - \sqrt{\cos^2(\delta) - \cos^2(\phi)}]}{[\cos(\delta) + \sqrt{\cos^2(\delta) - \cos^2(\phi)}]}$$

$$K_{ah} = 0.894 \times \frac{\{0.894 - \sqrt{(0.894\text{^}2 - 0.866\text{^}2)}\}}{\{0.894 + \sqrt{(0.894\text{^}2 - 0.866\text{^}2)}\}}$$

$$K_{ah} = \frac{0.601}{1.116}$$

K_{ah} = 0.538

$$\text{Lateral Pressure P} = \frac{K_{ah} \times W \times H^2}{2}$$

$$= \frac{0.538 \times 1.80 \times 1.24\text{^}2}{2}$$

= 0.740 t/m

Total Horizontal Pressure = P x Cos(δ)

= 0.740 x 0.894

= 0.662 t/m^2

Moment at junction of barrel & breast wall = $\frac{P \times \cos(\delta) \times H}{3}$

$$= \frac{0.662 \times 1.24}{3}$$

= 0.2726 t-m/m

= 2.726 KN-m/m

d effective required = $\sqrt{\frac{M}{Q \times b}}$

$$= \sqrt{\frac{2.72 \times 16\text{^}6}{1.110 \times 1000}}$$

= 49.56 mm

Diameter of bar = 12 mm

Clear Cover = 30 mm

d effective provided = 264 mm

A_{st} required = $\frac{M}{\sigma_{st} \times j \times d}$

= $\frac{0.27 \times 10^{\wedge}7}{230 \times 0.90 \times 264}$

= 49.89 mm^2

Provide 12 mm dia bars

Hence Spacing = $\frac{A\phi \times 1000}{A_{st}}$

= 2265.90 mm

Provide = 300.00 mm

Provide 12 mm dia bars @ 300 mm c/c as main bar.

But minimum steel required = 0.12% x 300 x 1000

= 360 mm^2

Provide 12 mm dia bars

Hence Spacing = $\frac{A\phi \times 1000}{A_{st}}$

= 314.00 mm

Provide = 300.00 mm

Provide 12 mm dia bars @ 300 mm c/c as distribution bar.

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SATNA NAGOD BRANCH CANAL KM. 55.600 KM. TO 83.00 KM.

Abstract of Umarhat Disty. N.H. AT R.D. 7100 M.

S.No.	Description	Qty.	Rate	Unit	Amount	UCSR Ref.
1	2	3	4	5	6	7
1	Earth work in excavation of foundation of structures as per drawing and technical specification, including setting out, construction of shoring and bracing, removal of stumps and other deleterious matter, dressing of sides and bottom as per relevant clauses of section 300 & 2100 in					
	Ordinary Soil Depth Up to 3 m.	367.924	61	Cum	22443	12.1 I (i)
2	Providing and laying Plain/Reinforced cement concrete in open foundation including form work shuttering etc. complete as per drawing and technical specifications and as per relevant clauses of sections 1500, 1700 & 2100 with .) PCC GRADE M15	227.416	4617	Cum	1049978	12.6
3	Supplying, fitting and placing HYSD bar reinforcement in super- structure complete as per drawing and technical specifications as per relevant clauses of section 1600 FE550	10.988	82810	tonne	909916	14.4
4	Providing and Placing Reinforced/Prestressed cement concrete in super-structure e/x reinforcement as per drawing and Technical Specification and as per relevant clauses of sections 1500, 1700 and 2300 in **RCC GRADE M 20**	5.891	5674	Cum.	33427	14.1 (A) (i) 2
5	Providing and Placing Reinforced/Prestressed cement concrete in super-structure e/x reinforcement as per drawing and Technical Specification and as per relevant clauses of sections 1500, 1700 and 2300 in **RCC GRADE M 25**	175.368	6286	Cum.	1102363	14.1 (B) (i) 2
6	Providing weep holes in Brick masonry/Plain/Reinforced concrete abutment, wing wall/return wall with 100 mm dia AC pipe, extending through the full width of the structure with slope of 1V :20H towards drawing foce. Complete as per drawing and Technical specifications	9.600	185	Rm	1776	13.9
7	Earth work in excavation of foundation of structures as per drawing and technical specification, including setting out, construction of shoring and bracing, removal of stumps and other deleterious matter, dressing of sides and bottom as per relevant clauses of section 300 & 2100 inBack Filling in Marshy Foundation Pits	57.125	308	Cum	17595	12.1 (Vi)
8	Embankment Construction with Material Obtained from Borrow Pits Construction of embankment with approved material having CBR>7 obtained from borrow pits with all lifts and leads, transporting to site, spreading, grading to required slope and compacting to meet requirement of table 300-1, 300-2 and as per relevent clauses of section-300.	375.000	155	Cum.	58125	3.13

S.No.	Description	Qty.	Rate	Unit	Amount	UCSR Ref.
9	Granular Sub-base with Well Graded Material (CBR>30 or more) (Table:- 400-1 & Table 400-2) Construction of granular sub-base by providing well graded material like natural sand crushed gravel or crushed stone having CBR >30, spreading in uniform layers with motor grader on prepared surface, mixing by mix in place method with rotavator or plant mix method at OMC, and compacting with vibratory rollers of 80 to 100 kN static weight to achieve the desired density, complete as per Clause 401 of Specification.	150.000	934	Cum	140100	4.1
10	Water Bound Macadam Providing, laying, spreading and compacting stone aggregates of specific sizes to water bound macadam specification including spreading in uniform thickness, hand packing, rolling with vibratory roller 8-10 tonnes in stages to proper grade and camber, applying and brooming requisite type of screening/ binding Materials to fill up the interstices of coarse aggregate, watering and compacting to the required density as per clause 404 of specification.	75.000	1347	Cum	101025	4.8 i (a)
11	Water Bound Macadam Providing, laying, spreading and compacting stone aggregates of specific sizes to water bound macadam specification including spreading in uniform thickness, hand packing, rolling with vibratory roller 8-10 tonnes in stages to proper grade and camber, applying and brooming requisite type of screening/ binding Materials to fill up the interstices of coarse aggregate, watering and compacting to the required density as per clause 404 of specification.	56.250	1250	Cum.	70313	4.8 ii (a)
	Total				3507060	
	Say				**35.07**	Lakhs
	Add 18% GST				**6.3127**	
	Total Amount				**41.3833**	**Lakhs**

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SATNA NAGOD BRANCH CANAL KM. 55.600 KM. TO 83.00 KM.

ESTIMATE

UMARHAT DISTY. N.H. AT R.D. 7100 M.

UCSR Item No.	Item of Work	Nos.	L	B	H/D	Quantity	REMARKS	
12.1	Earth work in excavation of foundation of structures as per drawing and technical specification, including setting out, construction of shoring and bracing, removal of stumps and other deleterious matter, dressing of sides and bottom as per relevant clauses of section 300 & 2100 in						AVG. top GL	Excavation G.L.
	Concrete Barral	1	4.10	30.00	1.83	225.09	338.234	336.404
	Shear key U/S	1	4.10	0.80	0.59	1.94	336.404	335.813
	Shear key D/S	1	4.10	0.80	0.60	1.97	336.390	335.790
	Head Wall U/S	2	2.70	2.50	2.52	34.03	338.234	335.713
	U/s well & barrel middle Flooring portion	1	3.14	2.35	2.12	15.66	338.234	336.113
	U/s well wall	1	3.14	2.50	2.42	19.02	338.234	335.813
	U/s Key wall	1	2.10	0.60	0.28	0.36	338.234	337.949
	Head Wall D/S	2	2.70	2.50	2.54	34.34	338.234	335.690
	D/s well & barrel middle Flooring portion	1	3.14	2.35	2.14	15.83	338.234	336.090
	D/s well wall	1	3.14	2.50	2.44	19.20	338.234	335.790
	D/s Key wall	1	2.10	0.60	0.38	0.49	338.234	337.849
	Total					**367.924**		**Cum.**
I (i)	Ordinary Soil Depth Up to 3 m.					**367.924**		**Cum.**
12.6	Providing and laying Plain/Reinforced cement concrete in open foundation including form work shuttering etc. complete as per drawing and technical specifications and as per relevant clauses of sections 1500, 1700 & 2100 with .) PCC GRADE M15							
	Barrel Pcc-1	1	3.10	27.70	0.10	8.587		
	Barrel Pcc-2	1	3.00	27.40	0.20	16.440		
	U/s Head wall pcc -1	2	2.35	2.25	0.10	1.058		
	U/s Head wall pcc -2	2	2.30	2.15	0.30	2.967		
	D/s Head wall pcc -1	2	2.35	2.25	0.10	1.058		
	D/s Head wall pcc -2	2	2.30	2.15	0.30	2.967		
	U/S Head wall 1 Step	2	2.30	1.75	0.90	7.245		
	U/S Head wall 2 Step	2	2.30	1.13	2.94	15.194		
	D/S Head wall 1 Step	2	2.30	1.75	0.90	7.245		
	D/S Head wall 2 Step	2	2.30	1.13	2.71	14.019		
	U/S Head wall parapet	2	2.30	0.40	0.40	0.736		
	D/S Head wall parapet	2	2.30	0.40	0.40	0.736		
	U/s & D/s well wall Circular pcc	2	3.14	3.13	0.30	5.89		
	U/s & D/s well wall pcc	2	3.14	2.00	0.30	3.77		
	U/s well wall Lift	1	7.86	1.05	4.38	36.10		
	D/s well wall Lift	1	7.86	1.05	3.76	31.00		
	U/s Notch deduction in well wall Lift	-1	0.50	1.68	1.00	-0.84		
	D/s Notch deduction in well wall Lift	-1	0.50	1.68	0.95	-0.80		
	U/s & D/s Key wall pcc	2	2.20	0.70	0.30	0.92		
	U/s & D/s Key wall	2	1.80	0.30	0.50	0.54		
	U/s & D/s Approach Slab PCC	2	3.50	27.97	0.15	29.37		
	U/s & D/s Dwarf wall PCC	2	0.90	30.00	0.30	16.20		
	U/s & D/s Dwarf wall	2	0.50	30.00	0.90	27.00		
	Total					**227.416**		**Cum.**

UCSR Item No.	Item of Work	Nos.	L	B	H/D	Quantity	REMARKS	
14.4	Supplying, fitting and placing HYSD bar reinforcement in super- structure complete as per drawing and technical specifications as per relevant clauses of section 1600 FE550							
	Barrel							
	Shear key Bar 12 MM Dia @ 150 mm	36	2.91		0.617	64.64		
	Shear key Disty Bar 12 MM Dia	40	2.52		0.888	89.51		
	Raft Main Bar 12 MM Dia @ 300 mm	101	2.772		0.888	248.62		
	Disty Bar 12 MM Dia @ 300 mm	18	29.92		0.888	478.24		
	Bentup Bar 16 MM Dia @ 300 mm	101	4.122		1.579	657.37		
	Raft Main Bar 12 MM Dia @ 300 mm	101	2.772		0.888	248.62		
	wall vertical Bar 12 MM Dia @ 300 mm	404	2.996		0.888	1074.82		
	wall Disty Bar 12 MM Dia @ 300 mm	32	29.92		0.888	850.21		
	Top & bottom Hunch Bar 10 MM Dia @ 300 mm	404	1.538		0.617	383.37		
	Bracket Bar 10 MM Dia @ 150 mm	400	2.59		0.617	639.21		
	Braket Disty Bar 12 MM Dia	14	29.92		0.888	371.97		
	Slab Main Bar 12 MM Dia @ 300 mm	101	2.52		0.888	226.01		
	Disty Bar 12 MM Dia @ 300 mm	18	29.92		0.888	478.24		
	Bentup Bar 16 MM Dia @ 300 mm	101	4.122		1.579	657.37		
	Slab Main Bar 12 MM Dia @ 300 mm	101	2.52		0.888	226.01		
	Approach slab Bottom Bar 10 MM Dia @ 300 mm B/s	26	28.44		0.617	456.23		
	Approach slab Bottom Bar 12 MM Dia @ 300 mm B/s	376	4.072		0.888	1359.59		
	Approach slab Bottom Bar 10 MM Dia @ 300 mm B/s	26	28.44		0.617	456.23		
	Approach slab Bottom Bar 10 MM Dia @ 300 mm B/s	190	4.08		0.617	478.30		
	Approach slab wearing coat Bar 8 MM Dia @ 300 mm B/s	172	4.22		0.395	286.71		
	Approach slab wearing coat Bar 8 MM Dia @ 300 mm B/s	88	4.16		0.395	144.60		
	Total					9875.88		
	Head Wall U/s & D/s							
	Main Bar 10 MM Dia @ 200 mm	24	4.456		0.617	65.98		
	Disty Bar 8 MM Dia @ 200 mm	44	2.22		0.395	38.58		
	Total					104.57		
	2 Nos Headwall					209.14		
	Parapet wall							
	Main Bar 12 MM Dia @ 150 mm	18	3.368		0.888	53.83		
	Disty Bar 12 MM Dia @ 300 mm	18	2.52		0.888	40.28		
	Crash Barrier							
	Main Bar 12 MM Dia @ 150 mm	20	3.104		0.888	55.13		
	Main Bar 12 MM Dia @ 150 mm	20	1.93		0.888	34.28		
	Disty Bar 10 MM Dia @ 150 mm	18	2.79		0.617	30.99		
	Total					120.39		
	2 Nos Crash Barrier					240.78		
	Wearing coat							
	Main Bar 8 MM Dia @ 200 mm	15	8.32		0.395	49.30		
	Disty Bar 8 MM Dia @ 200 mm	43	2.75		0.395	46.71		
	Total					96.00		
	2 Nos Wearing coat					192.01		

UCSR Item No.	Item of Work	Nos.	L	B	H/D	Quantity	REMARKS	
	U/s & D/s well							
	Main Bar 10 MM Dia @ 300 mm	27	3.98		0.617	66.30		
	Disty Bar 8 MM Dia @ 300 mm	13	7.755		0.395	39.82		
	Main Bar 12 MM Dia @ 300 mm	22	2.483		0.888	48.51		
	Disty Bar 12 MM Dia @ 300 mm	22	1.71		0.888	33.41		
	Total					188.04		
	2 Nos Well Wall					376.08		
	Grand Total					**10987.997**		**Kg.**
14.1 (A) (i) 2	Providing and Placing Reinforced/Prestressed cement concrete in super-structure e/x reinforcement as per drawing and Technical Specification and as per relevant clauses of sections 1500, 1700 and 2300 in RCC GRADE M 20							
	U/s RCC Flooring of well	1	3.14	3.125	0.300	2.95		
	D/s RCC Flooring of well	1	3.14	3.125	0.300	2.95		
	Total					**5.891**		**Cum.**
14.1 (B) (i) 2	Providing and Placing Reinforced/Prestressed cement concrete in super-structure e/x reinforcement as per drawing and Technical Specification and as per relevant clauses of sections 1500, 1700 and 2300 in RCC GRADE M 25							
	Barrel Shear key	2	0.95	2.60	0.89	4.402		
	Barral Raft	1	30.00	2.60	0.30	23.400		
	Bottom wall Hunch	2	30.00	0.50x 0.2	0.20	1.200		
	Barral WALL	2	30.00	0.30	1.80	32.400		
	Top wall Hunch	2	30.00	0.50x 0.2	0.20	1.200		
	Triangle Braket	2	0.15	27.91	0.30	2.512		
	Rectangular Braket	2	0.30	28.16	0.30	5.069		
	Barral Slab	1	30.00	2.60	0.30	23.400		
	Perapet Wall	2	2.60	0.30	1.24	1.942		
	Crash barrier	2	2.60	Area=.2936		1.527		
	L/s Approach Slab	1	28.16	3.80	0.30	32.102		
	R/s Approach Slab	1	28.16	3.80	0.30	32.102		
	Wearing coat	2	8.40	2.60	0.08	3.276		
	Aproach Slab B/s Wearing coat	2	8.40	4.30	0.08	5.418		
	Aproach Slab B/s Wearing coat	2	8.40	4.30	0.08	5.418		
	Total					**175.368**		**Cum.**
13.9	Providing weep holes in Brick masonry/Plain/Reinforced concrete abutment, Head wall/return wall with 100 mm dia AC pipe, extending through the full width of the structure with slope of 1V :20H towards drawing foce. Complete as per drawing and Technical specifications							
	Weep Hole	8	1.20			9.600		
	Total					**9.600**		**RM**
12.1 (Vi)	Earth work in excavation of foundation of structures as per drawing and technical specification, including setting out, construction of shoring and bracing, removal of stumps and other deleterious matter, dressing of sides and bottom as per relevant clauses of section 300 & 2100 inBack Filling in Marshy Foundation Pits							
	Head Wall U/S	1	28.16	2.30	0.44	28.563		
	Head Wall D/S	1	28.16	2.30	0.44	28.563		
	Total					**57.125**		**Cum.**
	Diverted Road							
3.13	Embankment Construction with Material Obtained from Borrow Pits Construction of embankment with approved material having CBR>7 obtained from borrow pits with all lifts and leads, transporting to site, spreading, grading to required slope and compacting to meet requirement of table 300-1, 300-2 and as per relevent clauses of section-300.							
	Embankment Construction	1	100.00	12.50	0.30	375.000		
	Total					**375.000**		**Cum**

UCSR Item No.	Item of Work	Nos.	L	B	H/D	Quantity	REMARKS	
4.1	**Granular Sub-base with Well Graded Material (CBR>30 or more) (Table:- 400-1 & Table 400-2)** Construction of granular sub-base by providing well graded material like natural sand crushed gravel or crushed stone having CBR >30, spreading in uniform layers with motor grader on prepared surface, mixing by mix in place method with rotavator or plant mix method at OMC, and compacting with vibratory rollers of 80 to 100 kN static weight to achieve the desired density, complete as per Clause 401 of Specification.							
	GSB 200 mm thick	1	100.00	7.50	0.20	150.000		
	Total					**150.000**		**Cum**
4.8 i (a)	**Water Bound Macadam** Providing, laying, spreading and compacting stone aggregates of specific sizes to water bound macadam specification including spreading in uniform thickness, hand packing, rolling with vibratory roller 8-10 tonnes in stages to proper grade and camber, applying and brooming requisite type of screening/ binding Materials to fill up the interstices of coarse aggregate, watering and compacting to the required density as per clause 404 of specification.							
	(i) Grading I (63 to 45 mm) (a) Using Screening Type A (13.2 mm Agg.)	1	100.00	7.50	0.10	75.000		
	Total					**75.000**		**Cum**
4.8 ii (a)	**Water Bound Macadam** Providing, laying, spreading and compacting stone aggregates of specific sizes to water bound macadam specification including spreading in uniform thickness, hand packing, rolling with vibratory roller 8-10 tonnes in stages to proper grade and camber, applying and brooming requisite type of screening/ binding Materials to fill up the interstices of coarse aggregate, watering and compacting to the required density as per clause 404 of specification.							
	(ii) Grading II (53 to 22.4 mm) (a) Using Screening Type B (11.2 mm Agg.)	1	100.00	7.50	0.075	56.250		
	Total					**56.250**		**Cum**

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GOVERNMENT OF MADHYA PRADESH

NARMADA VALLEY DEVELOPMENT AUTHORITY

BARGI DIVERSON PROJECT

NAGOD SATNA BRANCH CANAL FROM RD 55.600KM TO RD 83.00KM INCLUDING DISTRIBUTION SYSTEM

OFFTAKE FROM 5750 M OF UMARHAT DY RERUWA KALAN MR N.H. CROSSING AT RD - 1310 M

Prepared & Submitted By :

OFFSHORE INFRASTRUCTURES LIMITED, MUMBAI

Design of RERUWA KALAN MR N.H. CROSSING AT RD - 1310 M

CANAL DATA :-

1	Full Supply Discharge		(Q)	=	0.1266	Cumec
2	Bed Width		(B.W.)	=	0.3	M
3	Full Supply Depth		(F.S.D.)	=	0.3	M
4	Free Board		(F.B.)	=	0.45	M
5	Top Width of Bank :	Left		=	1.00	M
		Right		=	1.00	M
6	Bed Slope			=	1 in 300	
7	Side Slope :	Inner Slope	(I)	=	1.50 :1	
		Outer Slope	(O)	=	2.00 :1	
8	Velocity		(V)	=	0.957	M/Sec
9	Manning's "N"	Lined	(n)	=	0.018	
		Unlined	(n)	=	0.025	
10	Canal Bed Level		(C.B.L.)	=	333.459	M
11	Full Supply Level		(F.S.L.)	=	333.759	M
12	Top Bank Level		(T.B.L.)	=	334.209	M

BRIDGE DATA :-

1	Formation Level	(F.R.L.)	=	335.350	M
2	Ground Level	(G.L.)	=	334	M
3	Clear Width of Roadway		=	6.45	M
4	Pipe Length		=	7.5	M
5	Extra Beam Width		=	0.000	M
6	Extra Beam Height		=	0.000	M
7	Extra Beam Length		=	0.000	M
8	Extra Beam Rest on Pipe		=	0.000	M
9	Overall Length		=	7.500	M
10	Pipe Invert Level in U/s		=	333.109	M
11	Pipe Invert Level in D/s		=	333.108	M
12	D/s CBL	(C.B.L.)	=	333.359	M
13	D/s FSL	(F.S.L.)	=	333.659	M
14	D/s TBL	(T.B.L.)	=	334.109	M
15	BT RL		=	331.91	M

DESIGN OF PIPE FOR DISCHARGE :-

X- sectional area of Canal water way

Bed Width		=	0.30	M
Full Supply Depth		=	0.30	M
Water way	(A)	=	(0.3 + 1.5 x 0.3) x 0.3	
		=	0.23	Sq mts
Velocity	V_1	=	0.957	M/Sec

Water in pipe will run as open channel flow

Assume diameter of pipe = 1.00 M

As the depth of water is only 0.3 m, the pipe is depressed by 0.35 m to provide maximum sectional area available for flow.

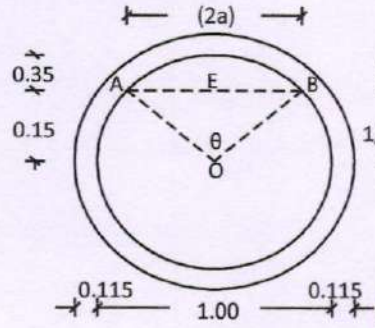
Hence X- sectional area of one pipe = 0.790 SqM

Manning's rougosity coefficient for RCC Pipe = 0.016

The pipe invert level in u/s = CBL - Depression of pipe

= 333.459 - 0.35

= 333.109 M



(C.B.L.) = 333.459 M

(F.S.L.) = 333.759 M

$\theta = 2 \times ACOS\left(\frac{0.3}{1.00}\right) \times \left(\frac{180}{\pi}\right)$

$\theta = 145.08°$

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1/2 width of pipe at canal F.S.L. AE (a) = $(OA^2 - EO^2)^{1/2}$

= (0.5 x 0.5 - 0.15 x 0.15) ^ 0.50

= 0.477 M

Area of upper segment of pipe remains unused = 4/3h x $(a^2+h^2)^{0.5}$

= 4/3 x 0.35 x (0.2275 + 0.1225) ^ 0.50

= 0.276 SqM

Hence net area of one pipe = Total Area - Area of upper segment of pipe remains unused

= 0.790 - 0.276

= 0.514 SqM

No. of rows of pipe = 1

By providing one row of pipe, X- sectional area = 0.514 SqM

Full Supply Discharge = 0.127 Cumecs

Hence Velocity through pipe to pass full discharge V_2 = (0.1266 / 0.514)

= 0.246 M/Sec

Total perimeter of one pipe = $2\pi r$

= 3.142 M

Length of upper arc = $\pi\theta r/180$

= (3.14 x 145.08 x 0.5)/180

= 1.265 M

Net wetted perimeter of one pipe = 3.142 - 1.265

= 1.877 M

Hydraulic mean depth of pipe not running full = A /P

= (0.514 / 1.877)

R = 0.274 M

$R^{2/3}$ = 0.422

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

= $\left(\frac{0.246 \times 0.016}{0.422}\right)^2$

Slope = 0.0001

Say = 1 in 10000

Length of Pipe = 7.50 M

= $\frac{7.50}{10000}$

Drop in pipe = 0.001 M

HEAD LOSS :-

Entry Loss = $0.20 \times \left(\frac{V_2^2 - V_1^2}{2g}\right)$ V_1= 0.246 M/Sec

V_2= 0.957 M/Sec

Entry Loss = $0.20 \times \frac{0.246^2 - 0.957^2}{2 \times 9.81}$ = -0.009 M

Exit Loss = $0.30 \times \frac{0.246^2 - 0.957^2}{2 \times 9.81}$ = -0.013 M

Total Head Loss = Drop in Pipe = -0.009 + 0.001 + -0.013

= -0.021 M

Head loss as per drop of canal = 7.5 / 10000

= 0.001 M

Provided Head Loss in Lsec = 0.1 M

Difference in head loss calculated and provided = -0.021-0.001

= -0.022 M

As there is 0.02M provision of head loss in canal L -section, Hence OK .

SCOUR DEPTH :-

In this case however the canal is lined scour depth need not be calculated. However calculations are given as below:-

when :- $d = 1.34\left(\frac{D_b^2}{K_{sf}}\right)^{1/3}$

d_{sm} = Mean Depth of Scour

D_b = The design Discharge for Foundation per Meter width of effective waterway.

K_{sf} = Silt Factor fro a representative sample of bed material obtained up to the level of anticipated deepest scour

K_{sf} = $1.76\ \sqrt{d_m}$

d_m = Weighted mean diameter in mm.

Particle Size = Heavy Sand

d_m = 1.29

K_{sf} = 1.999

D_b = 0.106

for Abutment $d = 1.34\left(\frac{0.106 \times 0.106}{1.999}\right)^{1/3} = 0.178$ M

Max Scour Depth (D_m) = $1.27 \times d_{sm}$ = 1.27×0.178 = 0.23 M

In the present case, F.S.L. = 333.759 M

Hence,

Maximum depth of sour is up to = 333.759 - 0.23 = 333.53 M

Below G.L. the foundation is provided 1.00 M below G.L. = 333.00 M

Below Canal Bed, the foundation is provided 1.20 M below Pipe inv = 331.91 M

Foundation Level of Head Wall = = 331.91 M

Hence Safe

DESIGN OF HEAD WALL-

The design of Head wall is not done. Its width has been adopted as per chart for wing walls in E-in-C publication 70/1

1 Effective height of wall up to top of foundation level = 335.35 - 332.209

= 3.141 M

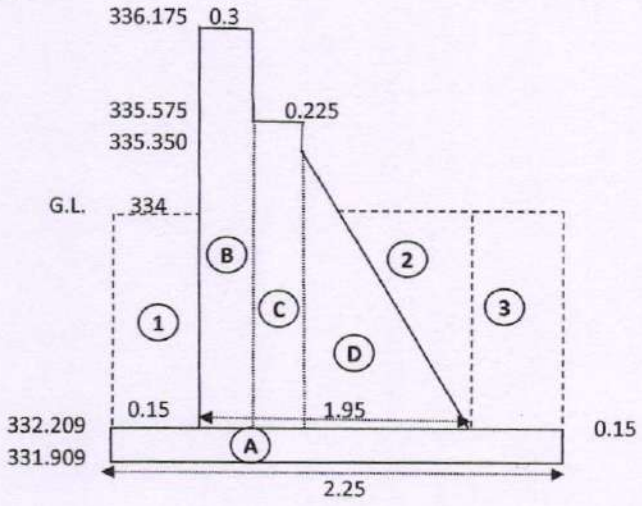
2 B/H factor as per E in C publication = 0.61

3 B/H Angle = 24.35°

4 Width required = 1.92 M

5 Width provided = 1.95 M

1.5 Wing Wall



Self Weight of wi = Wt. of part A + B + C + D

Weight of Part A = 2.25 x 0.3 x 2.4

= 1.62 T

Weight of Part B = 0.3 x 3.966 x 2.4

= 2.86 T

Weight of Part C = 0.225 x 3.366 x 2.4

= 1.82 T

Weight of Part D = 1/2 x 1.425 x 3.141 x 2.4

= 5.37 T

T. Self Wt of wing wall per m = 11.66 T

Weight of Earth above wall = Wt. of part 1 + 2 + 3

Weight of Part 1 = 0.15 x 1.791 x 1.8

Unit Weight of C.C. = 2.4 T/M

Unit Weight of Earth = 1.8 T/M

= 0.48 T

Weight of Part 2 = 1/2 x 0.812535816618905 x 1.791 x 1.8

= 1.31 T

Weight of Part 3 = 0.15 x 1.791 x 1.8

= 0.48 T

Total Weight of Earth per m = 2.28 T

$$\text{Stress} = \frac{\text{Total Load}}{\text{Area}}$$

Total Load = Total Weight of concrete + Earth

= 11.66 + 2.28

= 13.94 T

Area = 2.25 x 1

= 2.25 SqM

$$\text{Stress} = \frac{13.94}{2.25}$$

= 6.20 t/m^2 < **25.00 t/m^2**

Hence Safe

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SATNA NAGOD BRANCH CANAL KM. 55.600 KM. TO 83.00 KM.

Abstract of Reruwa kalan Minor N.H. AT R.D. 1310 M.

S.No.	Description	Qty.	Rate	Unit	Amount	UCSR Ref.
1	2	3	4	5	6	7
1	Earth work in excavation of foundation of structures as per drawing and technical specification, including setting out, construction of shoring and bracing, removal of stumps and other deleterious matter, dressing of sides and bottom as per relevant clauses of section 300 & 2100 in					
	Ordinary Soil Depth Up to 3 m.	144.663	61	Cum	8824	12.1 I (i)
2	Providing and laying Plain/Reinforced cement concrete in open foundation including form work shuttering etc. complete as per drawing and technical specifications and as per relevant clauses of sections 1500, 1700 & 2100 with .) PCC GRADE M15	59.704	4617	Cum	275652	12.6
3	Supplying, fitting and placing HYSD bar reinforcement in super- structure complete as per drawing and technical specifications as per relevant clauses of section 1600 FE550	2.157	82810	tonne	178607	14.4
4	Providing and Placing Reinforced/Prestressed cement concrete in super-structure e/x reinforcement as per drawing and Technical Specification and as per relevant clauses of sections 1500, 1700 and 2300 in **RCC GRADE M 25**	29.680	6286	Cum.	186569	14.1 (B) (i) 2
5	Providing weep holes in Brick masonry/Plain/Reinforced concrete abutment, wing wall/return wall with 100 mm dia AC pipe, extending through the full width of the structure with slope of 1V :20H towards drawing foce. Complete as per drawing and Technical specifications	7.200	185	Rm	1332	13.9
6	Providing and Laying Reinforced Cement Concrete Pipe NP4/prestrssed concrete pipe on first class bedding in single row. Providing and Laying Reinforced cement concrete pipe NP4/prestrssed concrete pipe for culverts on first class bedding of granular material (cost of bedding included) in single row including fixing collar with cement mortar 1:2 but excluding excavation, protection works, backfilling, concrete and masonry works in head walls and parapets. 1200 mm Dia Pipe	30.000	9544	Rm	286320	9.2 B
7	Earth work in excavation of foundation of structures as per drawing and technical specification, including setting out, construction of shoring and bracing, removal of stumps and other deleterious matter, dressing of sides and bottom as per relevant clauses of section 300 & 2100 inBack Filling in Marshy Foundation Pits	98.042	308	Cum	30197	12.1 (Vi)
8	Embankment Construction with Material Obtained from Borrow Pits Construction of embankment with approved material having CBR>7 obtained from borrow pits with all lifts and leads, transporting to site, spreading, grading to required slope and compacting to meet requirement of table 300-1, 300-2 and as per relevent clauses of section-300.	375.000	155	Cum.	58125	3.13

S.No.	Description	Qty.	Rate	Unit	Amount	UCSR Ref.
9	Granular Sub-base with Well Graded Material (CBR>30 or more) (Table:- 400-1 & Table 400-2) Construction of granular sub-base by providing well graded material like natural sand crushed gravel or crushed stone having CBR >30, spreading in uniform layers with motor grader on prepared surface, mixing by mix in place method with rotavator or plant mix method at OMC, and compacting with vibratory rollers of 80 to 100 kN static weight to achieve the desired density, complete as per Clause 401 of Specification.	150.000	934	Cum	140100	4.1
10	Water Bound Macadam Providing, laying, spreading and compacting stone aggregates of specific sizes to water bound macadam specification including spreading in uniform thickness, hand packing, rolling with vibratory roller 8-10 tonnes in stages to proper grade and camber, applying and brooming requisite type of screening/ binding Materials to fill up the interstices of coarse aggregate, watering and compacting to the required density as per clause 404 of specification.	75.000	1347	Cum	101025	4.8 i (a)
11	Water Bound Macadam Providing, laying, spreading and compacting stone aggregates of specific sizes to water bound macadam specification including spreading in uniform thickness, hand packing, rolling with vibratory roller 8-10 tonnes in stages to proper grade and camber, applying and brooming requisite type of screening/ binding Materials to fill up the interstices of coarse aggregate, watering and compacting to the required density as per clause 404 of specification.	56.250	1250	Cum.	70313	4.8 ii (a)
	Total				1337064	
	Say				**13.37**	Lakhs
	Add 18% GST				**2.4067**	
	Total Amount				**15.7774**	**Lakhs**

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SATNA NAGOD BRANCH CANAL KM. 55.600 KM. TO 83.00 KM.

ESTIMATE

RERUWA KALAN MINOR N.H. AT R.D. 1310 M.

UCSR Item No.	Item of Work	Nos.	L	B	H/D	Quantity	REMARKS	
12.1	Earth work in excavation of foundation of structures as per drawing and technical specification, including setting out, construction of shoring and bracing, removal of stumps and other deleterious matter, dressing of sides and bottom as per relevant clauses of section 300 & 2100 in						AVG. top GL	Excavation G.L.
	Head Wall U/S	1	4.82	2.35	2.19	24.84	334.000	331.809
	Head Wall D/S	1	4.82	2.35	2.19	24.84	334.000	331.809
	Pipe Barral	1	25.70	2.83	1.31	94.99	334.000	332.694
	Total					**144.663**		**Cum.**
I (i)	Ordinary Soil Depth Up to 3 m.					**144.663**		**Cum.**
II (i)	Ordinary Rock Depth Up to 3 m.					**0.000**		**Cum.**
III	Hard Rock (Requred Blasting)					**0.000**		**Cum.**
12.6	Providing and laying Plain/Reinforced cement concrete in open foundation including form work shuttering etc. complete as per drawing and technical specifications and as per relevant clauses of sections 1500, 1700 & 2100 with .) PCC GRADE M15							
	Head Wall U/S	1	3.82	2.35	0.10	0.899		
	Head Wall D/S	1	3.82	2.35	0.10	0.899		
	Pipe Barral	1	26.68	1.83	0.30	14.645		
	Head Wall U/S 1 Step	1	3.72	2.25	0.30	2.514		
	Head Wall U/S 2 Step	1	3.424	(0.525+1.950)/2	3.141	13.31		
	Pipe Deduction in Head wall U/s	-1	1.540	Area=1.188		-1.830		
	Head Wall D/S 1 Step	1	3.72	2.25	0.30	2.514		
	Head Wall D/S 2 Step	1	3.424	(0.525+1.950)/2	3.141	13.31		
	Pipe Deduction in Head wall D/s	-1	1.540	Area=1.188		-1.830		
	Half Pipe Barral	1	27.01	1.83	0.45	21.998		
	Deduct Pipe in half cradel concrerte	-1	27.01	Area=0.428		-11.562		
	Coller Joint	11	1.83	0.30	1.085	6.552		
	Deduct Pipe Barral	-11	0.30	Area=1.138		-3.755		
	Parapet kerb	2	3.42	0.53	0.23	0.809		
	Perapet Wall	2	3.42	0.30	0.60	1.23		
	Total					**59.704**		**Cum.**
14.4	Supplying, fitting and placing HYSD bar reinforcement in super- structure complete as per drawing and technical specifications as per relevant clauses of section 1600 FE550							
	Head Wall							
	Main Bar 10 MM Dia @ 200 mm	24	4.186		0.617	61.99		
	Disty Bar 8 MM Dia @ 200 mm	40	2.12		0.395	33.50		
	Total					95.48		
	2 Nos Headwall					190.96		
	Slab							
	Main Bar 12 MM Dia @ 150 mm	384	3.0		0.888	1022.98		
	Disty Bar 12 MM Dia @ 300 mm	20	28.722		0.888	510.10		
	Crash Barrier							
	Main Bar 12 MM Dia @ 150 mm	20	3.104		0.888	55.13		
	Main Bar 12 MM Dia @ 150 mm	20	1.93		0.888	34.28		
	Disty Bar 10 MM Dia @ 150 mm	18	2.79		0.617	30.99		
	Total					120.39		
	2 Nos Crash Barrier					240.78		

UCSR Item No.	Item of Work	Nos.	L	B	H/D	Quantity	REMARKS	
.	**Wearing coat**							
	Main Bar 8 MM Dia @ 200 mm	15	8.32		0.395	49.30		
	Disty Bar 8 MM Dia @ 200 mm	43	2.75		0.395	46.71		
	Total					96.00		
	2 Nos Wearing coat					192.01		
	Grand Total					**2156.832**		**Kg.**
14.1 (B) (i) 2	Providing and Placing Reinforced/Prestressed cement concrete in super-structure e/x reinforcement as per drawing and Technical Specification and as per relevant clauses of sections 1500, 1700 and 2300 in RCC GRADE M 25							
	Top Slab	1	2.83	28.80	0.30	24.452		
	Crash barrier	2	2.83	Area=.2936		1.662		
	Wearing coat	2	2.83	8.40	0.07	3.566		
	Total					**29.680**		**Cum**
9.2(B)	Providing and Laying Reinforced Cement Concrete Pipe NP4/prestrssed concrete pipe on first class bedding in single row. Providing and Laying Reinforced cement concrete pipe NP4/prestrssed concrete pipe for culverts on first class bedding of granular material (cost of bedding included) in single row including fixing collar with cement mortar 1:2 but excluding excavation, protection works, backfilling, concrete and masonry works in head walls and parapets.							
	1000 MM Dia NP4 PIPe	12	2.50			**30.000**		**RM.**
13.9	Providing weep holes in Brick masonry/Plain/Reinforced concrete abutment, wing wall/return wall with 100 mm dia AC pipe, extending through the full width of the structure with slope of 1V :20H towards drawing foce. Complete as per drawing and Technical specifications							
	Weep Hole	8	0.90			7.200		
	Total					**7.200**		**RM**
12.1 (Vi)	Earth work in excavation of foundation of structures as per drawing and technical specification, including setting out, construction of shoring and bracing, removal of stumps and other deleterious matter, dressing of sides and bottom as per relevant clauses of section 300 & 2100 inBack Filling in Marshy Foundation Pits							
	Head Wall U/S	1	3.30	0.84	2.86	7.979		
	Head Wall D/S	1	3.30	0.84	2.86	7.979		
	Pipe Barral	1	1.00	25.70	1.53	39.321		
	murrum	1	1.83	28.29	0.83	42.763		
	Total					**98.042**		**Cum.**
	Diverted Road							
3.13	Embankment Construction with Material Obtained from Borrow Pits Construction of embankment with approved material having CBR>7 obtained from borrow pits with all lifts and leads, transporting to site, spreading, grading to required slope and compacting to meet requirement of table 300-1, 300-2 and as per relevent clauses of section-300.							
	Embankment Construction	1	100.00	12.50	0.30	375.000		
	Total					**375.000**		**Cum**
4.1	**Granular Sub-base with Well Graded Material (CBR>30 or more) (Table:- 400-1 & Table 400-2)** Construction of granular sub-base by providing well graded material like natural sand crushed gravel or crushed stone having CBR >30, spreading in uniform layers with motor grader on prepared surface, mixing by mix in place method with rotavator or plant mix method at OMC, and compacting with vibratory rollers of 80 to 100 kN static weight to achieve the desired density, complete as per Clause 401 of Specification.							
	GSB 200 mm thick	1	100.00	7.50	0.20	150.000		
	Total					**150.000**		**Cum**

UCSR Item No.	Item of Work	Nos.	L	B	H/D	Quantity	REMARKS	
4.8 i (a)	**Water Bound Macadam** Providing, laying, spreading and compacting stone aggregates of specific sizes to water bound macadam specification including spreading in uniform thickness, hand packing, rolling with vibratory roller 8-10 tonnes in stages to proper grade and camber, applying and brooming requisite type of screening/ binding Materials to fill up the interstices of coarse aggregate, watering and compacting to the required density as per clause 404 of specification.							
	(i) Grading I (63 to 45 mm) (a) Using Screening Type A (13.2 mm Agg.)	1	100.00	7.50	0.10	75.000		
	Total					**75.000**		**Cum**
4.8 ii (a)	**Water Bound Macadam** Providing, laying, spreading and compacting stone aggregates of specific sizes to water bound macadam specification including spreading in uniform thickness, hand packing, rolling with vibratory roller 8-10 tonnes in stages to proper grade and camber, applying and brooming requisite type of screening/ binding Materials to fill up the interstices of coarse aggregate, watering and compacting to the required density as per clause 404 of specification.							
	(ii) Grading II (53 to 22.4 mm) (a) Using Screening Type B (11.2 mm Agg.)	1	100.00	7.50	0.075	56.250		
	Total					**56.250**		**Cum**

Sub Engineer
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Satna (M.P.)

Assistant Engineer (F-17....)
N.D. Division No. 7
Satna (M.P.)

GOVERNMENT OF MADHYA PRADESH

NARMADA VALLEY DEVELOPMENT AUTHORITY

BARGI DIVERSON PROJECT

NAGOD SATNA BRANCH CANAL FROM RD 55.600KM TO RD 83.00KM INCLUDING DISTRIBUTION SYSTEM

BAMURAHIYA MINOR N.H. CROSSING AT RD - 1575 M
OFFTAKE FROM 950 M OF ITMA MINOR

Prepared & Submitted By :

OFFSHORE INFRASTRUCTURES LIMITED, MUMBAI

Design of BAMURAHIYA MINOR N.H. CROSSING AT RD - 1575 M

CANAL DATA :-

1	Full Supply Discharge		(Q)	=	0.6552	Cumec
2	Bed Width		(B.W.)	=	0.45	M
3	Full Supply Depth		(F.S.D.)	=	0.5	M
4	Free Board		(F.B.)	=	0.45	M
5	Top Width of Bank :	Left		=	1.25	M
		Right		=	1.25	M
6	Bed Slope			=	1 in 350	
7	Side Slope :	Inner Slope	(I)	=	1.50 :1	
		Outer Slope	(O)	=	2.00 :1	
8	Velocity		(V)	=	1.228	M/Sec
9	Manning's "N"	Lined	(n)	=	0.018	
		Unlined	(n)	=	0.025	
10	Canal Bed Level		(C.B.L.)	=	322.843	M
11	Full Supply Level		(F.S.L.)	=	323.343	M
12	Top Bank Level		(T.B.L.)	=	323.793	M

BRIDGE DATA :-

1	Formation Level	(F.R.L.)	=	324.215	M
2	Ground Level	(G.L.)	=	322.770	M
3	Clear Width of Roadway		=	29.1	M
4	Pipe Length		=	30	M
5	Extra Beam Width		=	0.000	M
6	Extra Beam Height		=	0.000	M
7	Extra Beam Length		=	0.000	M
8	Extra Beam Rest on Pipe		=	0.000	M
9	Overall Length		=	30.000	M
10	Pipe Invert Level in U/s		=	321.843	M
11	Pipe Invert Level in D/s		=	321.810	M
12	D/s CBL	(C.B.L.)	=	322.743	M
13	D/s FSL	(F.S.L.)	=	323.243	M
14	D/s TBL	(T.B.L.)	=	323.693	M
15	BT RL		=	320.64	M

DESIGN OF PIPE FOR DISCHARGE :-

X- sectional area of Canal water way

Bed Width		=	0.45	M
Full Supply Depth		=	0.50	M
Water way	(A)	=	(0.45 + 1.5 x 0.5) x 0.5	
		=	0.60	Sq mts
Velocity	V_1	=	1.228	M/Sec

Water in pipe will run as open channel flow

Assume diameter of pipe = 1.00 M

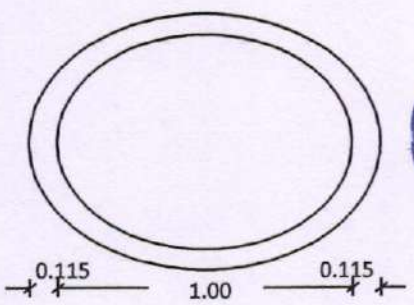
Hence X- sectional area of one pipe = 0.790 SqM

Manning's rougosity coefficient for RCC Pipe = 0.016

The pipe invert level in u/s = CBL - Depression of pipe

= 322.843 - 1

= 321.843 M



(C.B.L.) = 322.843 M

(F.S.L.) = 323.343 M

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Hence net area of one pipe = Total Area
= 0.790
= 0.790 sqm
No. of rows of pipe = 1
By providing one row of pipe, X- sectional area = 0.790 sqm
Full Supply Discharge = 0.655 Cumecs
Hence Velocity through pipe to pass full discharge V_2 = (0.6552 / 0.79)
= 0.829 M/Sec
Total perimeter of one pipe = $2 \pi r$
= 3.142 M
= 3.142 M
Hydraulic mean depth of pipe not running full = A /P
= (0.79 / 3.142)
R = 0.251 M
$R^{2/3}$ = 0.398
Slope = $\left(\frac{(V \times n)}{R^{2/3}}\right)^2$
= $\left(\frac{0.829 \times 0.016}{0.398}\right)^2$
Slope = 0.0011
Say = 1 in 909
Length of Pipe = 30.00 M
= $\frac{30.00}{909}$
Drop in pipe = 0.033 M

HEAD LOSS :-

3.1.2 **Head Loss C** Highest value of the following two is adopted

(I) By unwins for = $(1+f_1+f_2*L/R)\frac{V^2}{2g}$

where = 0.505 & f2 = a(1+b/R)

where a & b are as follows (5.11© E-In-C70/1)
For concrete 0.00316 and b = 0.03

R A/P = 0.251 m
f2 = #REF! = 0.0035

L = Length ofPipe
= 30.000
& her = $1 + 0.505+0.0035 \times (30/0.251) \times \frac{0.83^2}{2 \times 9.81}$
= 0.0670 m

Head loss as per drop of canal = 30 / 909
= 0.033 M
Provided Head Loss in Lsec = 0.1 M
Difference in head loss calculated and provided = 0.067-0.033
= 0.034 M

As there is provision of 0.1m head loss in canal L -section, Hence OK .

SCOUR DEPTH :-

In this case however the canal is lined scour depth need not be calculated. However calculations are given as below:-

when :-

$$d = 1.34\left(\frac{D_b^2}{K_{sf}}\right)^{1/3}$$

d_{sm} = Mean Depth of Scour

D_b = The design Discharge for Foundation per Meter width of effective waterway.

K_{sf} = Silt Factor fro a representative sample of bed material obtained up to the level of anticipated deepest scour

$K_{sf} = 1.76\sqrt{d_m}$

d_m = Weighted mean diameter in mm.

Particle Size = Heavy Sand

d_m = 1.29

K_{sf} = 1.999

D_b = 0.336

for Abutment

$$d = 1.34\left(\frac{0.336 \times 0.336}{1.999}\right)^{1/3} = 0.384 \text{ M}$$

Max Scour Depth (D_m) = $1.27 \times d_{sm}$ = 1.27×0.384 = 0.49 M

In the present case, F.S.L. = 323.343 M

Hence,

Maximum depth of sour is up to	=	323.343 - 0.49	=	322.855 M
Below G.L. the foundation is provided		1.00 M below G.L.	=	321.770 M
Below Canal Bed, the foundation is provided		1.20 M below INVERT LE	=	320.643 M
Foundation Level of Head Wall	=		=	320.643 M
				Hence Safe

DESIGN OF HEAD WALL-

The design of Head wall is not done. Its width has been adopted as per chart for wing walls in E-in-C publication 70/1

1	Effective height of wall up to top of foundation level	=	324.215 - 320.943
		=	3.272 M
2	B/H factor as per E in C publication	=	0.65
3	B/H Angle	=	26.33°
4	Width required	=	2.13 M
5	Width provided	=	2.15 M

DESIGN OF WELL IN U/S :

Area of waterway = 0.600 Sqm

Area required for well = 1.25 x Area of waterway

= 1.25 x 0.600

= 0.750 sqm

Min. distance required of fall wall = 1.25D + (h/4) As per E-in-C 70/1

where, D = Depth of Water

h = CBL of canal -U/S invert level of pipe

D = 0.50 m

h = 322.843 - 321.543

= 1.30 m

Min. distance required of fall wall = (1.25 x 0.5) + (1.30 /4)

= 0.95 m

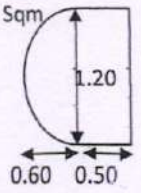
Dia. of well provided = width of pipe = 1.20 m

Area of well provided = $\frac{3.14 \times 1.2^2}{4 \times 2}$

= 0.57 Sqm

Extra area required = 0.75 - 0.6
= 0.185 Sqm

Length required = $\frac{0.18}{1.20}$
= 0.15 m
say = 1.00 m



istance of well wall from U/s = 0.60 + 1.00
= 1.60 m
> 0.95 m HENCE OK

Depth of water cushion
Provide depth of water cushion with R.C.C. floor = 0.30 m

Floor thickness of well = √(Depth of water + Drop)
= √(4.395 + 4.26)
= 2.94 feet
= 0.90 m
Provide Floor thickness of well = 0.30 m
i.e. provide top floor thickness with R.C.C. 1:2:4= 0.30 m
& remaining floor thickness with C.C. 1:3:6 = 0.30 m

Foundation level of U/S well = U/S Invert level of pipe - water cushion - Floo thickness of well
= 321.843 - 0.30 - 0.30 - 0.30
= 320.943 m
Provide Foundation level of well = 321.843 - 1.20 (1.20m below pipe invert)

Provide Foundation level of well = 320.643 m

DESIG OF NOTCH: Providing Trapezoidal type notch

Notch Width = 0.224 X Q X(WATER DEPTH) $^{-3/2}$
= 0.221 x 23.14 x 1.65 $^{-3/2}$
= 2.41 feet
= 0.74 m
say = 0.8 m

th of Notch = Bottom width of notch + 2d' TAN α
= 2.62 +2 x 1.65 X M Q $^{-5/2}$
= 2.62 +2 x 1.65 x 0.055 x 23 x x 1.65 $^{-5/2}$
= 3.83 feet
= 1.17 m
= 1.2 m

pitching in outer slope of canal is to be provided.

scharge through not = 4.46 X notch width x FSD $^{1.5}$
= 4.46 x 2.62 x 1.65 $^{1.5}$
= 0.702 cumecs
> 0.655 cumecs

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SATNA NAGOD BRANCH CANAL KM. 55.600 KM. TO 83.00 KM.

Abstract of Itma Minor N.H. AT R.D. 1575 M.

S.No.	Description	Qty.	Rate	Unit	Amount	UCSR Ref.
1	2	3	4	5	6	7
1	Earth work in excavation of foundation of structures as per drawing and technical specification, including setting out, construction of shoring and bracing, removal of stumps and other deleterious matter, dressing of sides and bottom as per relevant clauses of section 300 & 2100 in					
	Ordinary Soil Depth Up to 3 m.	194.888	61	Cum	11888	12.1 I (i)
2	Providing and laying Plain/Reinforced cement concrete in open foundation including form work shuttering etc. complete as per drawing and technical specifications and as per relevant clauses of sections 1500, 1700 & 2100 with .) PCC GRADE M15	91.687	4617	Cum	423319	12.6
3	Supplying, fitting and placing HYSD bar reinforcement in super- structure complete as per drawing and technical specifications as per relevant clauses of section 1600 FE550	2.221	82810	tonne	183892	14.4
4	Providing and Placing Reinforced/Prestressed cement concrete in super-structure e/x reinforcement as per drawing and Technical Specification and as per relevant clauses of sections 1500, 1700 and 2300 in **RCC GRADE M 20**	1.473	5674	Cum.	8357	14.1 (A) (i) 2
5	Providing and Placing Reinforced/Prestressed cement concrete in super-structure e/x reinforcement as per drawing and Technical Specification and as per relevant clauses of sections 1500, 1700 and 2300 in **RCC GRADE M 25**	29.680	6286	Cum.	186569	14.1 (B) (i) 2
6	Providing weep holes in Brick masonry/Plain/Reinforced concrete abutment, wing wall/return wall with 100 mm dia AC pipe, extending through the full width of the structure with slope of 1V :20H towards drawing foce. Complete as per drawing and Technical specifications	7.200	185	Rm	1332	13.9
7	Providing and Laying Reinforced Cement Concrete Pipe NP4/prestrssed concrete pipe on first class bedding in single row. Providing and Laying Reinforced cement concrete pipe NP4/prestrssed concrete pipe for culverts on first class bedding of granular material (cost of bedding included) in single row including fixing collar with cement mortar 1:2 but excluding excavation, protection works, backfilling, concrete and masonry works in head walls and parapets. 1200 mm Dia Pipe	30.000	9544	Rm	286320	9.2 B
8	Earth work in excavation of foundation of structures as per drawing and technical specification, including setting out, construction of shoring and bracing, removal of stumps and other deleterious matter, dressing of sides and bottom as per relevant clauses of section 300 & 2100 inBack Filling in Marshy Foundation Pits	108.770	308	Cum	33501	12.1 (Vi)

S.No.	Description	Qty.	Rate	Unit	Amount	UCSR Ref.
9	Embankment Construction with Material Obtained from Borrow Pits Construction of embankment with approved material having CBR>7 obtained from borrow pits with all lifts and leads, transporting to site, spreading, grading to required slope and compacting to meet requirement of table 300-1, 300-2 and as per relevent clauses of section-300.	375.000	155	Cum.	58125	3.13
10	Granular Sub-base with Well Graded Material (CBR>30 or more) (Table:- 400-1 & Table 400-2) Construction of granular sub-base by providing well graded material like natural sand crushed gravel or crushed stone having CBR >30, spreading in uniform layers with motor grader on prepared surface, mixing by mix in place method with rotavator or plant mix method at OMC, and compacting with vibratory rollers of 80 to 100 kN static weight to achieve the desired density, complete as per Clause 401 of Specification.	150.000	934	Cum	140100	4.1
11	Water Bound Macadam Providing, laying, spreading and compacting stone aggregates of specific sizes to water bound macadam specification including spreading in uniform thickness, hand packing, rolling with vibratory roller 8-10 tonnes in stages to proper grade and camber, applying and brooming requisite type of screening/ binding Materials to fill up the interstices of coarse aggregate, watering and compacting to the required density as per clause 404 of specification.	75.000	1347	Cum	101025	4.8 i (a)
12	Water Bound Macadam Providing, laying, spreading and compacting stone aggregates of specific sizes to water bound macadam specification including spreading in uniform thickness, hand packing, rolling with vibratory roller 8-10 tonnes in stages to proper grade and camber, applying and brooming requisite type of screening/ binding Materials to fill up the interstices of coarse aggregate, watering and compacting to the required density as per clause 404 of specification.	56.250	1250	Cum.	70313	4.8 ii (a)
	Total				1504740	
	Say				**15.05**	Lakhs
	Add 18% GST				**2.7085**	
	Total Amount				**17.7559**	**Lakhs**

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Satna (M.P.)

SATNA NAGOD BRANCH CANAL KM. 55.600 KM. TO 83.00 KM.

ESTIMATE

ITMA MINOR N.H. AT R.D. 1575 M.

UCSR Item No.	Item of Work	Nos.	L	B	H/D	Quantity	REMARKS	
12.1	Earth work in excavation of foundation of structures as per drawing and technical specification, including setting out, construction of shoring and bracing, removal of stumps and other deleterious matter, dressing of sides and bottom as per relevant clauses of section 300 & 2100 in						AVG. top GL	Excavation G.L.
	Head Wall U/S	1	5.30	2.55	2.23	30.10	322.770	320.543
	Well Wall U/S	1	3.14	2.75	2.13	18.38	322.770	320.643
	Head Wall D/S	1	5.30	2.55	2.23	30.10	322.770	320.543
	Well Wall D/S	1	3.14	2.75	2.13	18.38	322.770	320.643
	Pipe Barral	1	25.30	2.83	1.34	96.23	322.770	321.426
	U/s Key wall	1	2.10	0.60	0.63	0.79	322.770	322.143
	D/s Key wall	1	2.10	0.60	0.73	0.92	322.770	322.043
	Total					**194.888**		**Cum.**
I (i)	Ordinary Soil Depth Up to 3 m.					**194.888**		**Cum.**
II (i)	Ordinary Rock Depth Up to 3 m.					**0.000**		**Cum.**
III	Hard Rock (Requred Blasting)					**0.000**		**Cum.**
12.6	Providing and laying Plain/Reinforced cement concrete in open foundation including form work shuttering etc. complete as per drawing and technical specifications and as per relevant clauses of sections 1500, 1700 & 2100 with .) PCC GRADE M15							
	Head Wall U/S	1	4.30	2.55	0.10	1.097		
	Head Wall D/S	1	4.30	2.55	0.10	1.097		
	Pipe Barral	1	26.33	1.83	0.30	14.453		
	Head Wall U/S 1 Step	1	4.20	2.45	0.30	3.087		
	Head Wall U/S 2 Step	1	3.900	(0.525+2.150)/2	3.272	17.07		
	Pipe Deduction in Head wall U/s	-1	1.455	Area=1.188		-1.729		
	Head Wall D/S 1 Step	1	4.20	2.45	0.30	3.087		
	Head Wall D/S 2 Step	1	3.900	(0.525+2.150)/2	3.272	17.07		
	Pipe Deduction in Head wall D/s	-1	1.455	Area=1.188		-1.729		
	Half Pipe Barral	1	26.69	1.83	0.445	21.738		
	Deduct Pipe in half cradel concrerte	-1	26.69	Area=0.388		-10.357		
	Coller Joint	11	1.83	0.30	1.085	6.552		
	Deduct Pipe Barral	-11	0.30	Area=1.138		-3.755		
	Parapet kerb	2	3.90	0.53	0.23	0.921		
	Perapet Wall	2	3.90	0.30	0.68	1.58		
	U/s & D/s well wall Circular pcc	2	3.14	2.65	0.30	4.99		
	U/s & D/s well wall Lift	2	3.93	0.78	2.63	15.98		
	U/s & D/s Notch deduction inwell wall Lift	-2	0.50	1.00	0.50	-0.50		
	U/s & D/s Key wall pcc	2	2.10	0.60	0.20	0.50		
	U/s & D/s Key wall	2	1.80	0.30	0.50	0.54		
	Total					**91.687**		**Cum.**
14.4	Supplying, fitting and placing HYSD bar reinforcement in super- structure complete as per drawing and technical specifications as per relevant clauses of section 1600 FE550							
	Head Wall							
	Main Bar 10 MM Dia @ 200 mm	17	4.392		0.617	46.07		
	Disty Bar 8 MM Dia @ 200 mm	21	3.19		0.395	26.46		
	Total					72.53		
	2 Nos Headwall					145.06		

UCSR Item No.	Item of Work	Nos.	L	B	H/D	Quantity	REMARKS	
	Slab							
	Main Bar 12 MM Dia @ 150 mm	384	3.0		0.888	1022.98		
	Disty Bar 12 MM Dia @ 300 mm	20	28.722		0.888	510.10		
	Crash Barrier							
	Main Bar 12 MM Dia @ 150 mm	20	3.104		0.888	55.13		
	Main Bar 12 MM Dia @ 150 mm	20	1.93		0.888	34.28		
	Disty Bar 10 MM Dia @ 150 mm	18	2.79		0.617	30.99		
	Total					120.39		
	2 Nos Crash Barrier					240.78		
	Wearing coat							
	Main Bar 8 MM Dia @ 200 mm	15	8.32		0.395	49.30		
	Disty Bar 8 MM Dia @ 200 mm	43	2.75		0.395	46.71		
	Total					96.00		
	2 Nos Wearing coat					192.01		
	U/s & D/s well							
	Main Bar 10 MM Dia @ 300 mm	14	2.85		0.617	24.58		
	Disty Bar 8 MM Dia @ 300 mm	9	3.828		0.395	13.61		
	Main Bar 12 MM Dia @ 300 mm	10	0.94		0.888	8.35		
	Disty Bar 12 MM Dia @ 300 mm	10	0.938		0.888	8.33		
	Total					54.86		
	2 Nos wall well					109.72		
	Grand Total					**2220.645**		**Kg.**
14.1 (A) (i) 2	Providing and Placing Reinforced/Prestressed cement concrete in super-structure e/x reinforcement as per drawing and Technical Specification and as per relevant clauses of sections 1500, 1700 and 2300 in RCC GRADE M 20							
	U/s RCC Flooring of well	1	3.14	0.781	0.300	0.74		
	D/s RCC Flooring of well	1	3.14	0.781	0.300	0.74		
	Total					**1.473**		**Cum.**
14.1 (B) (i) 2	Providing and Placing Reinforced/Prestressed cement concrete in super-structure e/x reinforcement as per drawing and Technical Specification and as per relevant clauses of sections 1500, 1700 and 2300 in RCC GRADE M 25							
	Top Slab	1	2.83	28.80	0.30	24.452		
	Crash barrier	2	2.83	Area=.2936		1.662		
	Wearing coat	2	2.83	8.40	0.07	3.566		
	Total					**29.680**		**Cum**
14.1 (C) (i) 2	Providing and Placing Reinforced/Prestressed cement concrete in super-structure e/x reinforcement as per drawing and Technical Specification and as per relevant clauses of sections 1500, 1700 and 2300 in RCC GRADE M 30							
	Total					**0.00**		**Cum**
9.2(B)	Providing and Laying Reinforced Cement Concrete Pipe NP4/prestrssed concrete pipe on first class bedding in single row. Providing and Laying Reinforced cement concrete pipe NP4/prestrssed concrete pipe for culverts on first class bedding of granular material (cost of bedding included) in single row including fixing collar with cement mortar 1:2 but excluding excavation, protection works, backfilling, concrete and masonry works in head walls and parapets.							
	1000 MM Dia NP4 PIPe	12	2.50			**30.000**		**RM.**

UCSR Item No.	Item of Work	Nos.	L	B	H/D	Quantity	REMARKS	
13.9	Providing weep holes in Brick masonry/Plain/Reinforced concrete abutment, wing wall/return wall with 100 mm dia AC pipe, extending through the full width of the structure with slope of 1V :20H towards drawing foce. Complete as per drawing and Technical specifications							
	Weep Hole	8	0.90			7.200		
	Total					**7.200**		**RM**
12.1 (Vi)	Earth work in excavation of foundation of structures as per drawing and technical specification, including setting out, construction of shoring and bracing, removal of stumps and other deleterious matter, dressing of sides and bottom as per relevant clauses of section 300 & 2100 inBack Filling in Marshy Foundation Pits							
	Head Wall U/S	1	3.77	0.91	2.97	10.230		
	Head Wall D/S	1	3.77	0.91	2.97	10.230		
	Pipe Barral	1	1.00	25.40	1.53	38.862		
	murrum	1	1.83	28.18	0.96	49.449		
	Total					**108.770**		**Cum.**
	Diverted Road							
3.13	Embankment Construction with Material Obtained from Borrow Pits Construction of embankment with approved material having CBR>7 obtained from borrow pits with all lifts and leads, transporting to site, spreading, grading to required slope and compacting to meet requirement of table 300-1, 300-2 and as per relevent clauses of section-300.							
	Embankment Construction	1	100.00	12.50	0.30	375.000		
	Total					**375.000**		**Cum**
4.1	**Granular Sub-base with Well Graded Material (CBR>30 or more) (Table:- 400-1 & Table 400-2)** Construction of granular sub-base by providing well graded material like natural sand crushed gravel or crushed stone having CBR >30, spreading in uniform layers with motor grader on prepared surface, mixing by mix in place method with rotavator or plant mix method at OMC, and compacting with vibratory rollers of 80 to 100 kN static weight to achieve the desired density, complete as per Clause 401 of Specification.							
	GSB 200 mm thick	1	100.00	7.50	0.20	150.000		
	Total					**150.000**		**Cum**
4.8 i (a)	**Water Bound Macadam** Providing, laying, spreading and compacting stone aggregates of specific sizes to water bound macadam specification including spreading in uniform thickness, hand packing, rolling with vibratory roller 8-10 tonnes in stages to proper grade and camber, applying and brooming requisite type of screening/ binding Materials to fill up the interstices of coarse aggregate, watering and compacting to the required density as per clause 404 of specification.							
	(i) Grading I (63 to 45 mm) (a) Using Screening Type A (13.2 mm Agg.)	1	100.00	7.50	0.10	75.000		
	Total					**75.000**		**Cum**
4.8 ii (a)	**Water Bound Macadam** Providing, laying, spreading and compacting stone aggregates of specific sizes to water bound macadam specification including spreading in uniform thickness, hand packing, rolling with vibratory roller 8-10 tonnes in stages to proper grade and camber, applying and brooming requisite type of screening/ binding Materials to fill up the interstices of coarse aggregate, watering and compacting to the required density as per clause 404 of specification.							
	(ii) Grading II (53 to 22.4 mm) (a) Using Screening Type B (11.2 mm Agg.)	1	100.00	7.50	0.075	56.250		
	Total					**56.250**		**Cum**

Sub Engineer
N.D. Division No. 7
Satna (M.P.)

Assistant Engineer (F-...14..)
N.D. Division No. 7
Satna (M.P.)