

**DESIGN CALCULATION AND DRAWING FOR  
TRANSVERSE GUIDED BEARING**

**(Ch. 500+578)**

**PROJECT:** FOUR LANING OF JHANJHI TO DEMOW SECTION OF NH-37 FROM EXISTING CH. K 491+050 TO KM 535+250  
(DESIGN CH. KM 4900+800 TO KM 534+800) IN THE STATE OF ASSAM UNDER EPC MOD

**CLIENT:** NATIONAL HIGHWAYS & INFRASTRUCTURE DEVELOPMENT CORPORATION LTD. (NHIDCL)

**CONTRACTOR :** M/S KAMAC-SHIVA HARLALKA (JV)

**MANUFACTURER:**



**M/S KARMA ENTERPRISE, GUWAHATI, ASSAM**

**Design Calculation of SLS- 2641 KN, ULS- 4497 KN Transverse Guided Bearing**

TYPE OF BEARING :  
REVISION :

TG  
00

TYPE: B2  
CH: 500+578

Conc. Grade for Pedestal M 45  
Conc. Grade for Superstructure M 50

**DESIGN DATA FOR BEARING DESIGN (LOADS)**

LOADING PARAMETERS	SLS			ULS	
UNITS	MT	kN		MT	kN
VERTICAL MAXIMUM LOAD	269.30	2641.00		458.56	4497.00
VERTICAL MINIMUM LOAD	141.23	1385.00		213.63	2095.00
VERTICAL PERMANENT LOAD	156.83	1538.00			
HORIZONTAL LOADS					
ACTING IN LONGITUDINAL DIRECTION	8.87	87.00		13.36	131.00
ACTING IN TRANSVERSE DIRECTION	0.00	0.00		0.00	0.00
RESULTANT HORIZONTAL LOADS		87.00			131.00
DISPLACEMENT					
LONGITUDINAL (MM)	0.00	0.00		0.00	
TRANSVERSE (MM)	+ 20.00	-20.00		40.00	
ROTATION (RADIAN)	0.0038	+	0	=	0.0038

Assume Permanent Rotation      q p      =      0.52      x      0.004      =      0.002  
Assume Variable Rotation      q v      =      0.48      x      0.004      =      0.002

**MATERIALS**

Steel Stress (Working) for Design Use      340 MPa (Grade-340-570W)      AS PER IS - 1030  
HT Bolts shall conform to Grade 8.8 of IS : 1364  
Elastomer shall be of hardness 50 + / - 5 conforming to IRC : 83 (Part III) - 2018 Table - 4.3

**DIMENSION DETAILS OF BEARING COMPONENTS**

**ELASTOMERIC PAD**

PAD DIAMETER      =      di      450 mm  
PAD THICKNESS      =      he      32 mm

**PTFE**

PTFE DIAMETER      =      Dptfe      450 mm  
PTFE THICKNESS      =      Tptfe      5 mm

**CYLINDER**

CYLINDER CONCRETE CONTACT DIAMETER      =      Do      540 mm  
CYLINDER BASE THICKNESS      =      kb      35 mm  
CYLINDER INNER DIAMETER      =      Di = di      450 mm  
CYLINDER OUTER DIAMETER      =      do      500 mm  
HEIGHT OF CYLINDER      =      he      44 mm  
WALL THICKNESS      =      Tew      25.0 mm

**INTERMEDIATE COMPONENT**

LENGTH      =      Lic      490 mm  
WIDTH      =      Wic      490 mm  
INTERMEDIATE COMPONENT ABOVE THICKNESS      =      Tp      14 mm  
INTERMEDIATE COMPONENT PROJECTION      =      hp      23 mm  
VERTICAL FACE      =      w      6 mm

**TOP PLATE**

EFFECTIVE CONCRETE CONTACT DIAMETER      =      Dtpeff      515 mm  
LENGTH      =      Lt      560 mm  
WIDTH      =      Bl      535 mm  
THICKNESS      =      Tt      30 mm  
S/S SHEET LENGTH      =      Lss      550 mm  
S/S SHEET WIDTH      =      Bss      495 mm  
S/S SHEET THICKNESS      =      Tss      3 mm  
GUIDE BAR LENGTH      =      Lgb      560 mm  
GUIDE BAR WIDTH      =      ku      15 mm  
GUIDE BAR HEIGHT      =      Hgb      20 mm



**Design Calculation of SLS- 2641 KN, ULS- 4497 KN Transverse Guided Bearing**

**ANCHORAGE**

BOLTS DIAMETER	=	Dbolt	20 mm
BOLTS LENGTH	=	Lbolt	45 mm
BOLTS PER COMPONENT	=	Nbolt	4 NOS.
GRADE OF BOLTS	=	GR.bolt	8.8
ANCHORAGE COLLOR LENGTH	=	CL	70 mm
ANCHORAGE COLLOR THICKNESS	=	C thk	14 mm
SLEEVE LENGTH ( Superstructure)	=	Ls	110 mm
SLEEVE DIAMETER ( Superstructure)	=	Ds	50 mm
SLEEVE LENGTH ( Pedestal)	=	Lp	120 mm
SLEEVE DIAMETER ( Pedestal)	=	Dp	50 mm

**GENERAL**

NO. OF BRASS SEALING RINGS	=	Nbr	2 NOS.
TOTAL THICKNESS OF RINGS	=	Tbr	4.0 mm
GAP BETWEEN CYLINDER & TOP COMPONENT	=	h4	11 mm
<b>TOTAL BEARING ASSEMBLY HEIGHT</b>	=	HT	139.2 mm

**Calculation for Permissible Stresses in Pedestal Concrete**

**BOTTOM**

Cylinder Concrete Contact Diameter =		540	mm
Loaded area ( $A_{co} = p \times Db \wedge 2/4$ ) =		229022.11	mm <sup>2</sup>
Required Pedestal Size for Dispersion =	1080.00	x	1080 mm
Dispersed area ( $A_{cl} = p \times d \wedge 2/4$ ) =		916088.42	mm <sup>2</sup>

**TOP**

Top Component Contact Diameter =		515	mm
Loaded area ( $A_2 = p \times Db \wedge 2/4$ ) =		208307.23	mm <sup>2</sup>
Required Superstructure Size for Dispersion =	1030.00	x	1030 mm
Dispersed area ( $A_1 = p \times d \wedge 2/4$ ) =		833228.92	mm <sup>2</sup>

**DESIGN CALCULATIONS :-**

REF. CODE : IRC:83 (Part-III)-2018

**1.1 DESIGN OF PAD (Clause - 5.2.3.2)**

Effective diameter of Pad	Dpad		450 mm
Area of pad = $p \times d \wedge 2/4$	a		159107.143 mm <sup>2</sup>
Vertical Load	Nsd	4497.00	kN
Direct Pressure Nsd / a	pa	28.27	N/mm <sup>2</sup>
(Nsd / a ) x Ym		36.75	N/mm <sup>2</sup>
fc,k		60.00	N/mm <sup>2</sup>
		<b>OK</b>	

**Check Compression at edge of Neoprene Pad (Clause - 5.2.3.4)**

Max. Permitted = 15 % of hc		4.80	mm
Desired Rotation		0.00380	radians
Available Rotation in Radius due to Compression of Pad		0.02133	radians
			<b>OK</b>
Diameter / Thickness Ratio	14.06	Maximum (Dpad/hc)	15
			<b>OK</b>

**Check for Min. average Stress (Clause - 5.2.3.3)**

Min. average stress = (Nsd min. / a)		8.70	N/mm <sup>2</sup>
Permissible Min. average stress =		2.00	N/mm <sup>2</sup>
		<b>OK</b>	

### Design Calculation of SLS- 2641 KN, ULS- 4497 KN Transverse Guided Bearing

#### Pressure on PTFE

Diameter of PTFE	L	450.00	mm
Area of PTFE	Aco	159043.13	mm <sup>2</sup>
Average pressure on PTFE = $N_{max} ULS / A_p$	$\sigma_p$	28.28	N/mm <sup>2</sup>
Protrusion of PTFE			
$h = 1.75 + L / 1200$		2.13	mm
h provided		2.20	mm
Thickness of PTFE = 2.2h		4.84	mm
Thickness of PTFE provided		5.00	mm
		<b>OK</b>	
Characteristic compressive strength of PTFE	fk	90.00	N/mm <sup>2</sup>
The Characteristic compressive strength is reduced due to exceeding the category temperature above 30°C.			
Max. ambient temperature		40.00	°C
Reduction		20.00	%
Reduction factor	k	0.80	
$\mu_{max} = 1.2 / (10 + \sigma_p)$		0.031	
	0.03	$\leq$	0.031
$e1 = \mu_{max} \times R$		7.05	mm
$e3 = \sigma_d \times L/2$		0.86	mm
$e = e1 + e3$		7.91	mm
	L/8	56.25	mm
		<b>OK</b>	
$\lambda = (1 - 0.75 \times \pi \times e / L)$	$\lambda$	0.96	
Reduced contact area $A_r = A_{co} \times \lambda$	$A_r$	152456.80	mm <sup>2</sup>
$\max, N_{sd} = A_r \times k \times f_k / \gamma_m$	$\gamma_m = 1.4$	7840.64	kN
$N_{sd}, ULS$		4497.00	kN
		<b>OK</b>	

#### STRESS IN BOTTOM CONCRETE

Bottom dispersion width	Do	540	
Thickness of Bottom Plate	kb	35	
Area of Bottom Dispersion = $p \times d^{2/4}$	a	229114.286	mm <sup>2</sup>
Section Modulus = $p \times d^{3/32}$	Z	15465214.286	mm <sup>3</sup>
Vertical Load	Nsd	4497.00	kN
Horizontal force	Vsd	131.00	kN
Moment of resistance due to rotation:			
Rotation due to dead load	$\theta_p$	0.00199	radians
Live Load	$\theta_v$	0.00181	radians
Ratio = $d_i / h_e$		14.06	
For induced moment	k1	2.05	
	k2	85.18	
Induced moment due to rotation $M_{e,d}$			
$d_i^3 \times (k1 \times q_p + K2 \times q_v) / 1000$	$M_{e,d}$	14398.94	kN-mm
Moment of resistance due to HF:			
Horizontal distance	C	225.00	mm
Resultant HF	Vsd	131.00	kN
Moment of resistance due to HF:	$M_{r,d}$	5895.00	kN-mm
$0.2 \times C \times Vsd$			
Total Movement = $M_{e,d} + M_{r,d}$	$M_t$	20293.94	kN-mm
Direct Pressure $N_{sd} / a$	pa	19.63	N/mm <sup>2</sup>
Permissible Stress $(0.67 \times f_{ck}) / 1.5$	fcd	20.10	N/mm <sup>2</sup>
		<b>OK</b>	
Bending Stress $M_t / Z$	pb	1.31	N/mm <sup>2</sup>
Permissible bending stress		14.85	N/mm <sup>2</sup>
		<b>OK</b>	
Area on Pedestal	AcI	916088.42	mm <sup>2</sup>
$F_{rdu} = A_{co} \times f_{cd} \times (\sqrt{AcI / A_{co}})$		9206.69	kN
$3 \times f_{cd} \times A_{co}$		13810.03	kN
$F_{rdu} \leq 3 \times f_{cd} \times A_{co}$		<b>OK</b>	

**Design Calculation of SLS- 2641 KN, ULS- 4497 KN Transverse Guided Bearing**  
STRESSING IN TOP CONCRETE

Top dispersion width Thickness of Top Plate		Dtpeff Tt	515 30	
Area of Top Dispersion = $p \times d^{2/4}$	a	208391.071	mm <sup>2</sup>	
Section Modulus = $p \times d^{3/32}$	Z	13415175.223	mm <sup>3</sup>	
Vertical Load	Nsd	4497.00	kN	
Horizontal force	Vsd	131.00	kN	
Moment of resistance due to rotation:				
Rotation due to dead load	$\theta_p$	0.00199	radians	
Live Load	$\theta_v$	0.00181	radians	
Ratio = $d_i / h_e$		14.06		
For induced moment	k1	2.05		
	k2	85.18		
Induced moment due to rotation	Me.d			
$d_i^3 \times (k1 \times q_p + k2 \times q_v) / 1000$		14398.94	kN-mm	
Moment of resistance due to HF:				
Horizontal distance	C	225.00	mm	
Resultant HF	Vsd	131.00	kN	
Moment of resistance due to HF:	Mr.d	5895.00	kN-mm	
$0.2 \times C \times Vsd$				
Total Movement = $Me.d + Mr.d =$	Mt	20293.94	kN-mm	
Direct Pressure $Nsd / a$	pa	21.58	N/mm <sup>2</sup>	
Permissible Stress $(0.67 \times f_{ck}) / 1.5$	fcd	22.33	N/mm <sup>2</sup>	
		OK		
Bending Stress $Mt / Z$	pb	1.51	N/mm <sup>2</sup>	
Permissible bending stress		16.50	N/mm <sup>2</sup>	
		OK		
Area on Superstructure	Ac1	833228.92	mm <sup>2</sup>	
$Frd_u = Aco \times f_{cd} \times (\sqrt{Ac1 / Aco})$		9304.39	kN	
$3 \times f_{cd} \times Aco$		13956.58	kN	
$Frd_u \leq 3 \times f_{cd} \times Aco$		OK		
<b>Pot walls subjected to tensile force (Clause 5.3.1.2.3)</b>				
$AR = (d_o - d_i) \times h_c$	AR	2200.00	mm <sup>2</sup>	
$Ve_{sd} = 4 \times Nsd \times h_c / \pi \times d_i$	Ve,sd	407.37	kN	
$Vf_{xy,sd}$		131.00	kN	
$Vsd = Ve_{sd} + Vf_{xy,sd}$		538.37	kN	
$Vrd = f_y \times AR / Y_m$	Ym =	680.00	kN	
		1.1		
		OK		
<b>Pot walls subjected to shear force (Clause 5.3.1.2.4)</b>				
$V'_{sd} \leq V'_{rd}$				
$V'_{sd} = Ve_{sd} + 1.5 \times Vf_{xy,sd} / d_i$		1.34	kN	
$V'_{rd} = (f_y \times (d_o - d_i)) / (2 \times Y_m \times (\sqrt{3}))$	Ym = 1.1	5.15	kN	
		OK		
<b>Pot base subjected to tensile force (Clause 5.3.1.2.5)</b>				
$Vsd \leq Vrd$				
$Ap = d_o \times kb$		17500.00	mm <sup>2</sup>	
$Vsd = Ve_{sd} + Vf_{xy,sd}$		538.37	kN	
$Vrd = f_y \times Ap / Y_m$	Ym =	5409.09	kN	
		1.1		
		OK		
<b>Design resistance for integral guides</b>				
<b>Shear resistance</b>				
Thickness of guide	ku	15.00	mm	
Height of guide	Hgb	20.00	mm	
Length of guide	Lgb	560.00	mm	
Length of side sliding	L	490.00	mm	
Height of application	ha	11.50	mm	
Effective length of guide	Leff	513.00	mm	
$Vsd \leq VRd$	Ym =	1.1		
$VRd = ku \times Leff \times f_y / \sqrt{3} \times Y_m$		1373.20	kN	
Vsd		131.00	kN	
		OK		



### Design Calculation of SLS- 2641 KN, ULS- 4497 KN Transverse Guided Bearing

Bending resistance in combination with shear resistance

$P = ((2 \times V_{sd} / V_{Rd}) - 1)^2$	0.65	
$f'_{ty} = (1 - P) \times f_y$	117.36	
$M_{Rd} = k_u \times 2 \times L_{eff} \times f'_{ty} / (4 \times Y_m)$	3078.80	kN-mm
$M_{sd} = V_{sd} \times h_a$	1506.50	kN-mm
	<b>OK</b>	

#### Movement Capacity

Size of Top Plate	Lt	=	560.00	mm
	Bt	=	535.00	mm
Effective contact Concrete Diameter	Dtpeff	=	515.00	mm
Preset (If Any)		=	0.00	mm
Long. Movement Capacity (Lt - Dtpeff)		=	45.00	mm
Movement in One Direction		=	22.50	mm
Permissible Movement		=	20.00	mm
			<b>OK</b>	
Movement in Other Direction		=	22.50	mm
Permissible Movement		=	20.00	mm
			<b>OK</b>	

#### Anchor Bolts

Max Horizontal Force		131.00	kN
Min. Vertical Load		<b>2095.00</b>	kN
Frictional Force		<b>0.00</b>	kN
Diameter of Bolt		<b>20.00</b>	mm
Length of Bolt		<b>45.00</b>	mm
Number of Bolts	n	<b>4.00</b>	Nos.
Thickness of Collar	Ct	14.00	mm
Factor for Net Area	kn	0.78	
Effec. Area of Bolt ( $p \times d^2 \times kn / 4$ )	Abolt	245.14	mm <sup>2</sup>
$\sigma_v$		0.60	
$f_{ub}$		800.00	N/mm <sup>2</sup>
$Y_{m^2}$		1.25	
$f_u$		570.00	N/mm <sup>2</sup>
$k_2$		0.90	
Shear resistance $F_{v,Rd} = \sigma_v \times f_{ub} \times A / Y_{m^2}$	$F_{v,Rd}$	94.13	kN
Resultant horizontal force / bolt $V_{fx,sd} / n$	$F_{v,sd}$	32.75	kN
		<b>OK</b>	
Bearing resistance $F_{b,Rd} = 1.25 \times f_u \times d \times t / Y_{m^2}$	$F_{b,Rd}$	159.60	kN
Resultant horizontal force / bolt $V_{fx,sd} / n$		32.75	kN
		<b>OK</b>	
Tension resistance $F_{t,Rd} = k_2 \times f_{ub} \times A_s / Y_{m^2}$	$F_{t,Rd}$	141.20	kN
Design tension resistance	$F_{t,sd}$	8.70	kN
Combined shear and tension $= F_{v,sd} / F_{v,Rd} + F_{t,sd} / (1.4 \times F_{t,Rd})$		0.39	
		<b>OK</b>	

#### Anchor Sleeves (Clause - 5.3.6.4.2)

<b>Top Plate</b>			
Length of Sleeve		<b>110.00</b>	mm
Diameter of Sleeve		<b>50.00</b>	mm
Number of Sleeves		4.00	Nos.
Resistance offered by concrete $FR_{du} = 1.33 D \times L \times f_{cd} / \sqrt{3}$		94.32	kN
Design resistance in shear		32.75	kN
		<b>OK</b>	
<b>Bottom Plate</b>			
Length of Sleeve		120.00	mm
Diameter of Sleeve		<b>50.00</b>	mm
Number of Sleeves		4.00	Nos.
Resistance offered by concrete $FR_{du} = 1.33 D \times L \times f_{cd} / \sqrt{3}$		92.61	kN
Design resistance in shear		32.75	kN
		<b>OK</b>	

**Design Calculation of SLS- 2641 KN, ULS- 4497 KN Transverse Guided Bearing**

**Requirement of clearance**

$\delta = 0.01 \times D_i$	min. = 3	4.50	<	10	mm
$h_c - h_e - (w - w_e) \times 0.5 - (\theta \times 0.5 \times D_i)$		8.52			mm
$\delta$		4.50			mm
		<b>OK</b>			
$h_p - (h_c - h_e) - (\theta \times 0.5 \times D_p)$		10.07			mm
$\delta$		4.50			mm
		<b>OK</b>			

**Curved Contact Surface** (Clause - 5.3.1.4.2)

$V_{sd} \leq V_{rd}$	R	=	225.00	mm
	$f_u$	=	570.00	N/mm <sup>2</sup>
	$\theta$	=	0.004	Radian
	$Y_m$	=	1.10	
$V_{rd} = 15 \times f_u^2 \times R \times D_i / E_s \times Y_m^2$		=	2039.0	kN
$V_{sd}$		=	131.00	kN
		=	<b>OK</b>	
$w_e = 3.04 \times (\text{sqrt}(1.5 \times V_{sd} \times R / E_s \times D_i))$		=	0.75	mm
$w_c + \theta \times D_i$		=	2.46	mm
Provided	w	=	6.00	mm
		=	<b>OK</b>	







B1		FIXED BEARING
B2		TRANS GUIDED BEARING
B3		LONG GUIDED BEARING
B4		FREE BEARING
B5		PIN BEARING
B6		METALLIC GUIDED BEARING



1. ALL DIMENSIONS ARE IN MILLIMETERS. LEVELS ARE IN METERS AND UNLESS OTHERWISE SPECIFIED, ALL WRITTEN DIMENSIONS SHALL BE FOLLOWED.
2. THE CONCRETOR SHALL START DESIGN, DRAWING OF MINIMUM APPROVAL OF THE ENGINEER.
3. THE CONCRETOR SHALL BE GIVEN 15 DAYS BEFORE FOR APPROVAL OF THE ENGINEER.
4. BEARINGS SHALL BE PROVIDED FROM THE LIST OF APPROVED MATERIALS BY MORTH.
5. ALL BEARINGS SHALL CONFORM TO THE LATEST NATIONAL SPECIFICATION (IS: 456) PART VI-2018 AND BRITISH STANDARD, IF ANY.
6. THE TESTING OF RAW MATERIALS, MATERIAL COMPOSITIONS, ESTIMATION & PILE AND ACCEPTANCE TESTS OF BEARINGS SHALL CONFORM TO LATEST SPECIFICATION UNDER SPECIFICATION.
7. MATERIALS SHALL BEAR THE CERTIFICATIONS FOR LOAD TESTING AND DIMENSIONS OF BEARINGS FOR SIZE, TOLERANCES AND MANUFACTURING SHALL BE PROVIDED FOR CONSTRUCTION AND MANUFACTURING.
8. THE SIZE AND WEIGHT OF PILEHEAD SHALL BE ADJUSTED TO SUIT THE FINISHED SIZE OF BEARINGS AT THE TIME OF CONSTRUCTION.
9. THE DIMENSIONS OF BEARINGS SHALL BE OF HIGH STRENGTH FIBRE REINFORCED CONCRETE TYPE.

DRG. NO. HEDICURSUSUP/MAR97-01-

DATE : MAR. 2023

REVISION

TITLE:

BEARING LOAD DATA FOR I  
BRIDGE  
AT KM+500+578