

Form No. 2

Bridge Design

1. Cable Design

2. Anchor Block Design

3. Bridge Standard Drawings

Bridge Name:

River Name:

District Name:

Designed by:

Date:

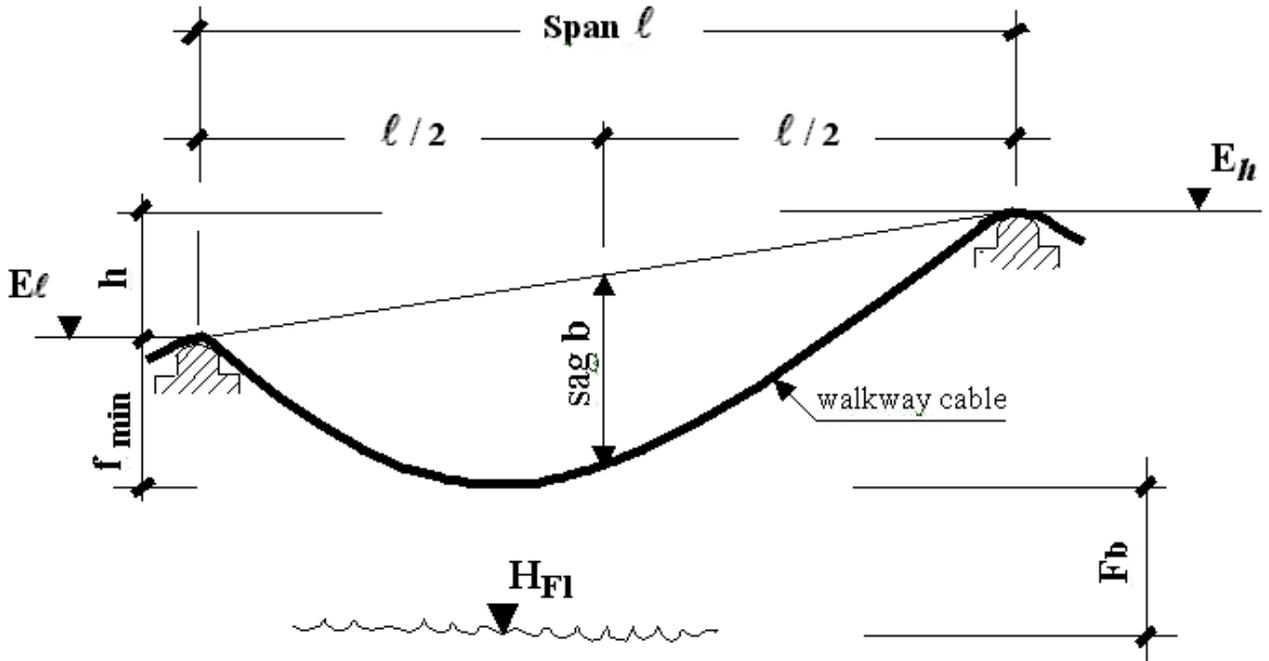
Bridge No: Bridge Name : District:

Span: m,

Walkway Width (70 or 106): cm

1. Cable Design for Suspended Bridge Type

A. Survey Data and Calculation of Freeboard



1. Span of the Bridge $l = \dots\dots\dots$ m
2. Saddle Elevation of the Walkway Cable on the **higher** Side $E_h = \dots\dots\dots$ m
3. Saddle Elevation of the Walkway Cable on the **lower** Side $E_l = \dots\dots\dots$ m
4. Difference in Elevation $h = E_h - E_l = h = \dots\dots\dots$ m
(max. permissible height: $h_{max} = l/25$)
5. **Dead Load Sag:** for Span up to 80m: $b_d = \frac{l}{20} = b_d = \dots\dots\dots$ m
for Span over 80m: $b_d = \frac{l}{22} = b_d = \dots\dots\dots$ m
6. f_{min} in Dead Load Case $f_{min} = \frac{(4 \cdot b_d - h)^2}{16 \cdot b_d} = f_{min} = \dots\dots\dots$ m
(at the lowest point of the cable)
7. Highest Flood Level $H_{Fl} = \dots\dots\dots$ m
8. **Free Board** (min. 5.00m) $F_b = E_l - H_{Fl} - f_{min} = F_b = \boxed{\dots\dots\dots}$ m

(if the freeboard is less than 5.00m, **try** either to raise the saddle elevations or to adjust the span, but keep the ratio between span and sag always **fixed** at $l/b_d = 20$ or $l/b_d = 22$)

B. Selection of Cables

Select a cable combination according to the span and walkway width of the bridge. Always select the higher cable combination, when the span is in between two values.

Maximum Span for Walkway Width:		Cable Combinations				Weight of all Cables g _h [kg/m]
70cm	106cm	Handrail Cables		Walkway Cables		
span [m]	span [m]	nos	Ømm	nos	Ømm	
50	40	2	26	2	26	10.04
90	60	2	26	2	32	12.62
100	75	2	26	4	26	15.06
120	105	2	26	4	32	20.22
----	120	2	32	4	32	22.80

Above cable combinations are calculated for the following specifications:

Cables: construction 7 x 19, wire strand core, **160 kg/mm²** (1.57 kN/mm²) tensile strength of wire

Safety Factor: minimum **3** or higher than 3

Live load $p = (300 + \frac{5000}{span}) \text{ kg/m}^2$ or $(3 + \frac{50}{span}) \text{ kN/m}^2$

or $p = 400 \text{ kg/m}^2$ (4 kN/m²) if the span is 50.0 m or less

Sag to Span Ratio: = **20** for Spans up to 80 meters
(in dead load case) = **22** for Spans over 80 meters

Max. permissible Height Difference of Saddles: $h = \frac{span}{25}$

Example: width of walkway = 70cm; span = 88m
 \Rightarrow selected cable combination: Handrail Cables 2 Ø 26mm
 Walkway Cables 2 Ø 32mm
 Weight of Cables = 12.62kg/m

Selected Cable Combination and Parameters from the Table above:

HRC	Handrail Cables:	nos	2	Ø	.....mm
WWC	Walkway Cables:	nos	.....	Ø	.....mm
	Weight of all Cables per meter			g _h	..... kg/m

C. Calculation of Cable Length

Type of Cable	Dia (mm)	Nos	Backstay Length * [m]	Cutting Length** [m/pc]
Fixation Cable	13	2	.....	.....
Handrail Cable	.....	2	.....	.....
Walkway Cable	.....	.....	.....	.....

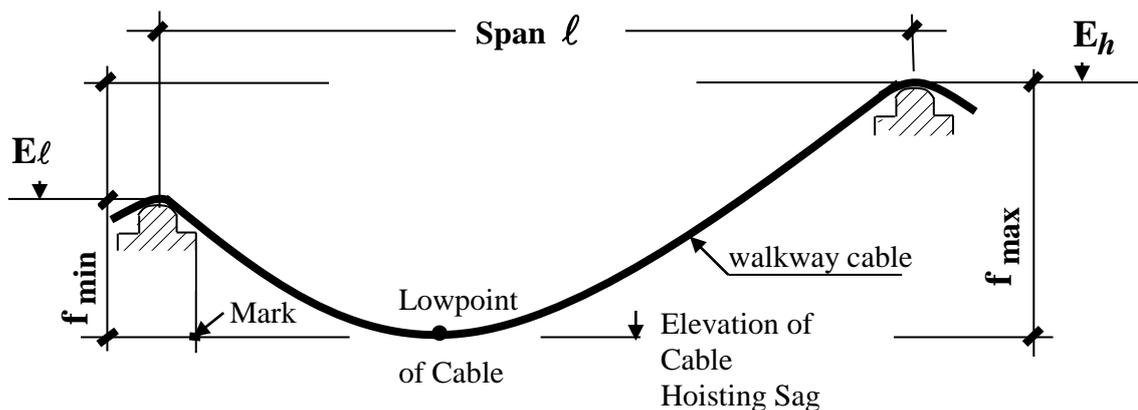
*Backstay Length = Cable length between saddle center and center of dead man or drum as per foundation drawing (both banks) + 6.0m. Calculate backstay length after selection of foundation blocks.

**Cutting Length = 1.1 x Span + Backstay Lengths

D. Calculation of (f_{min} & f_{max}) Hoisting Sag

This calculation has to be made after tower and foundation work is completed

1. Actual Span measured in the Field	ℓ	=	.....m
2. Saddle Elevation of the walkway cable <i>on the higher side</i>	E_h	=	.....m
3. Saddle Elevation of the walkway cable <i>on the lower side</i>	E_ℓ	=	.....m
4. Difference in Elevation	$h = E_h - E_\ell$	= h	=m
5. Dead Load Sag <i>for Spans up to 80m</i>	$b_d = \frac{\ell}{20}$	= b_d	=m
<i>for Spans over 80m</i>	$b_d = \frac{\ell}{22}$	= b_d	=m
6. Hoisting Sag	$b_h = 0.95 \times b_d$	= b_h	=m
7. f_{min} (in hoisting case)	$f_{min} = \frac{(4 \cdot b_h - h)^2}{16 \cdot b_h}$	= f_{min}	=m
8. f_{max} (in hoisting case)	$f_{max} = f_{min} + h$	= f_{max}	=m
9. Elevation of Cable low point (in hoisting case)	$E_\ell - f_{min}$	=	.....m



2. Anchorage Type (Foundation) Design for Suspended Bridge Type

A. Design Data * Fill in the following Design Data from Form No. 1: Survey Form and Checklist

<ul style="list-style-type: none"> • Walkway Width, WW (70 or 106cm): cm • Bridge Span: m 			
<i>Right Bank Condition</i>			
Geology:	Soil <input type="checkbox"/>		
If Soil , how is the Ground Surface?	Flat <input type="checkbox"/> (up to 10° slope)	or	Hill Slope <input type="checkbox"/> (more than 10° slope)
What is the Soil Type?	Gravelly <input type="checkbox"/>	Sandy <input type="checkbox"/>	Silty <input type="checkbox"/>
Tower Height from Ground up to H.C.Saddle (data from bridge profile):	2.4m <input type="checkbox"/>	3.4m <input type="checkbox"/>	4.4m <input type="checkbox"/>
If Rock , what is the Rock Type?	Hard Rock <input type="checkbox"/> (only few fractures)	Hard Rock <input type="checkbox"/> (highly fractured)	Soft Rock <input type="checkbox"/>
Tower Height	2.0m in Case of Rock <input type="checkbox"/>		
<i>Left Bank Condition</i>			
Geology	Soil <input type="checkbox"/>		
If Soil , how is the Ground Surface?	Flat <input type="checkbox"/> (up to 10° slope)	or	Hill Slope <input type="checkbox"/> (more than 10° slope)
What is the Soil Type?	Gravelly <input type="checkbox"/>	Sandy <input type="checkbox"/>	Silty <input type="checkbox"/>
Tower Height from Ground up to H.C.Saddle (data from bridge profile):	2.4m <input type="checkbox"/>	3.4m <input type="checkbox"/>	4.4m <input type="checkbox"/>
If Rock , what is the Rock Type?	Hard Rock <input type="checkbox"/> (only few fractures)	Hard Rock <input type="checkbox"/> (highly fractured)	Soft Rock <input type="checkbox"/>
Tower Height	2.0m in Case of Rock <input type="checkbox"/>		

B. Selection of Anchorage Types

Select appropriate anchorage type at Right and Left Bank according to the above design data.

Procedure for Selection:

- According to the Soil/Rock type and Slope of the ground, refer to respective tables for selection of Anchorage Types as per below.
 - for Soil and Flat Ground : **Table 1**
 - for Soil and Hill Slope : **Table 2**
 - for Hard Rock : **Table 3 or Table 4**
 - for Fractured Hard Rock or Soft Rock:
 - Span up to 90m (WW = 70cm) and upto 60m (WW = 106cm) : **Table 5 or Table 6**
 - Span Range 91-120m (WW = 70cm), 61-120m (WW = 106cm): **Table 7**
- **In the Table match the Design Data:** Selected Walkway Width → Bridge Span → Tower Height → Soil Type → Select the corresponding Anchor Type and Drawing No. for right bank and for left bank respectively.

Anchor Type Selection Tables

- *In Soil and Flat Ground:*

Table 1: Selection of Gravity Soil Anchor Block in Flat Ground

Span Range, m		Tower Height [m]	Foundation Soil Type	Block Type	Drawing No.
Walkway:70cm	Walkway:106cm				
Up to 45m	Up to 30m	2.4	All	1F	21Dcon
		3.4		2F	22Dcon
		4.4		3F	23Dcon
46 - 90	31 - 60	2.4	All	4F	24Dcon
		3.4		5F	25Dcon
		4.4		6F	26Dcon
91 - 120	61 - 75	2.4	All	7F	27Dcon
		3.4		8F	28Dcon
		4.4		9F	29Dcon
-	76 - 90	2.4	All	10F	30Dcon
		3.4		8F	28Dcon
		4.4		11F	31Dcon
-	91 - 105	2.4	All	12F	32Dcon
		3.4		8F	28Dcon
		4.4		13F	33Dcon
-	106 – 120	2.4	Gravelly	12F	32Dcon
			Sandy, Silty	14F	34Dcon
		3.4	All	15F	35Dcon
				4.4	13F	33Dcon

- *In Soil and Slope Ground:*

Table 2: Selection of Gravity Soil Anchor Block in Hill Slope

Span Range, m		Tower Height [m]	Foundation Soil Type	Block Type	Drawing No.
Walkway:70cm	Walkway:106cm				
Up to 60m	Up to 40m	2.4	All	1S	41Dcon
61 – 90	41- 60	2.4	All	2S	42Dcon
91 - 120	61-75	2.4	All	3S	43Dcon
-	76 - 90	2.4	Gravelly	4S	44Dcon
			Sandy	5S	45Dcon
			Silty	6S	46Dcon
-	91 - 105	2.4	Gravelly, Sandy	7S	47Dcon
			Silty	8S	48Dcon
-	106 - 120	2.4	Gravelly, Sandy	8S	48Dcon
			Silty	9S	49Dcon

• ***In Hard Rock for all Span Ranges:***

Table 3: Selection of RCC Single Drum Anchor in Hard Rock

Span Range, m		Tower Height [m]	Block Type	Drawing No.
Walkway:70cm	Walkway:106cm			
up to 90	up to 60	2.0	1HRS	61Dcon
91 – 120	61 - 120	2.0	2HRS	62Dcon

When slope is too steep and there is not enough space for single drum anchorage system (Table 3), select the double drum system from following table 4.

Table 4: Selection of RCC Double Drum Anchor in Hard Rock

Span Range, m		Tower Height [m]	Block Type	Drawing No.
Walkway:70cm	Walkway:106cm			
up to 90	up to 60	2.0	1HRD	63Dcon
91 – 120	61 - 120	2.0	2HRD	64Dcon

• ***In Fractured Hard Rock/Soft Rock for Span Range up to 90m (WW = 70 cm) and 60m (WW = 106cm):***

Table 5: Selection of RCC Single Drum Anchor in Fractured Hard Rock/Soft Rock

Span Range, m		Tower Height [m]	Block Type	Drawing No.
Walkway:70cm	Walkway:106cm			
up to 90	up to 60	2.0	1FRS	65Dcon

When slope is too steep and there is not enough space for single drum anchorage system (Table 5), select the double drum system from following table 6.

Table 6: Selection of RCC Double Drum Anchor in Fractured Hard Rock/Soft Rock

Span Range, m		Tower Height [m]	Block Type	Drawing No.
Walkway:70cm	Walkway:106cm			
up to 90	up to 60	2.0	1FRD	66Dcon

• ***In Fractured Hard Rock/Soft Rock for Span Rang of 91- 120m (WW = 70 cm) and 61-120m (WW = 106cm):***

Table 7: Selection of RCC Deadman Anchor in Fractured Hard Rock/Soft Rock

Span Range, m		Tower Height [m]	Block Type	Drawing No.
Walkway:70cm	Walkway:106cm			
91-120	61-120	2.0	2FRD	67Dcon

Selected Anchorage Foundation Type and corresponding Drawings from the Table above:

Right Bank: Anchor Type	Drawing No.....
Left Bank: Anchor Type	Drawing No.....

Example:

Design Data

* Fill in the following Design Data from Form No. 1: Survey Form and Checklist

<ul style="list-style-type: none"> • Walkway Width, WW (70 or 106cm): .....70..... cm • Bridge Span: .....88..... m 			
Right Bank Condition			
Geology:	Soil <input type="checkbox"/>		
If Soil , how is the Ground Surface?	Flat <input type="checkbox"/> (up to 10° slope)	or	Hill Slope <input type="checkbox"/> (more than 10° slope)
What is the Soil Type?	Gravelly <input type="checkbox"/>	Sandy <input type="checkbox"/>	Silty <input type="checkbox"/>
Tower Height from Ground up to H.C.Saddle (data from bridge profile):	2.4m <input type="checkbox"/>	3.4m <input type="checkbox"/>	4.4m <input type="checkbox"/>
If Rock , what is the Rock Type?	Hard Rock <input type="checkbox"/> (only few fractures)	Hard Rock <input type="checkbox"/> (highly fractured)	Soft Rock <input type="checkbox"/>
Tower Height	2.0m in Case of Rock <input type="checkbox"/>		
Left Bank Condition			
Geology	Soil <input type="checkbox"/>		
If Soil , how is the Ground Surface?	Flat <input type="checkbox"/> (up to 10° slope)	or	Hill Slope <input type="checkbox"/> (more than 10° slope)
What is the Soil Type?	Gravelly <input type="checkbox"/>	Sandy <input type="checkbox"/>	Silty <input type="checkbox"/>
Tower Height from Ground up to H.C.Saddle (data from bridge profile):	2.4m <input type="checkbox"/>	3.4m <input type="checkbox"/>	4.4m <input type="checkbox"/>
If Rock , what is the Rock Type?	Hard Rock <input type="checkbox"/> (only few fractures)	Hard Rock <input type="checkbox"/> (highly fractured)	Soft Rock <input type="checkbox"/>
Tower Height	2.0m in Case of Rock <input type="checkbox"/>		

⇒ **Selected Anchorage Types:**

Right Bank: Block Type 5F, Drawing No. 25Dcon
 Left Bank: Drum Type 1HRS, Drawing No.61Dcon

3. Bridge Standard Drawings

Select the required Steel Drawings and Construction Drawings from the following Drawing List.

3.1 Steel Drawings

Drawing Title	Drawing No	Required Drawing
Walkway Cross Beams	02D or 02D4 or 03D or 03D4	.....
Saddle and Reinforcement for RCC Deadman and Gravity Soil Anchor	20D2 or 20D4	RB:
		LB:
Saddle and Reinforcement for RCC Deadman Anchor in Soft or Fractured Hard Rock	20D4S	RB:
		LB:
Saddle and Reinforcement for Drum Rock Anchor	60D2 or 60D4	RB:
		LB:
Steel Deck	08A, 09A and 10A	08A, 09A, 10A

3.2 Construction Drawings

Drawing Title	Drawing No	Required Drawing
Walkway Fitting	19Dcon70 or 19Dcon106	.....
Details of Cement Stone Masonry Tower & RCC Core	20Dcon70 or 20Dcon106	.....
RCC Deadman and Gravity Soil Anchor Block for Flat Ground	21Dcon.....35 Dcon	RB:
		LB:
RCC Deadman and Gravity Soil Anchor Block for Hill Slope	41Dcon.....49Dcon	RB:
		LB:
RCC Single Drum Rock Anchor in Hard Rock	61Dcon or 62Dcon	RB:
		LB:
RCC Double Drum Rock Anchor in Hard Rock	63Dcon or 64Dcon	RB:
		LB:
RCC Single Drum Rock Anchor in Soft or Fractured Hard Rock	65Dcon	RB:
		LB:
RCC Double Drum Rock Anchor in Soft or Fractured Hard Rock	66Dcon	RB:
		LB:
RCC Deadman in Soft or Fractured Hard Rock	67Dcon	RB:
		LB:

Designed by:

Date:

Cable hoisted by:

Date:

Example:⇒ *Selected Drawings***Steel Drawings**

Drawing Title	Drawing No	Required Drawing
<i>Walkway Cross Beams</i>	<i>02D or 02D4 or 03D, or 03D4</i>	02D
<i>Saddle and Reinforcement for RCC Deadman and Gravity Soil Anchor</i>	<i>20D2 or 20D4</i>	RB: 20D2
		LB: x
<i>Saddle and Reinforcement for RCC Deadman Anchor in Soft or Fractured Hard Rock</i>	<i>20D4S</i>	RB: x
		LB: 60D2
<i>Saddle and Reinforcement for Drum Rock Anchor</i>	<i>60D2 or 60D4</i>	RB: 60D2
		LB: x
<i>Steel Deck</i>	<i>08A, 09A, 10A</i>	08A, 09A, 10A

Construction Drawings

Drawing Title	Drawing No	Required Drawing
<i>Walkway Fitting</i>	<i>19Dcon70 or 19Dcon106</i>	19Dcon70
<i>Details of Cement Stone Masonry Tower & RCC Core</i>	<i>20Dcon70 or 20Dcon106</i>	20Dcon70
<i>RCC Deadman and Gravity Soil Anchor Block for Flat Ground</i>	<i>21Dcon.....35 Dcon</i>	RB: 25Dcon
		LB: x
<i>RCC Deadman and Gravity Soil Anchor Block for Hill Slope</i>	<i>41Dcon.....49Dcon</i>	RB: x
		LB: x
<i>RCC Single Drum Rock Anchor in Hard Rock</i>	<i>61Dcon or 62Dcon</i>	RB: x
		LB: 61Dcon
<i>RCC Double Drum Rock Anchor in Hard Rock</i>	<i>63Dcon or 64Dcon</i>	RB: x
		LB: x
<i>RCC Single Drum Rock Anchor in Soft or Fractured Hard Rock</i>	<i>65Dcon</i>	RB: x
		LB: x
<i>RCC Double Drum Rock Anchor in Soft or Fractured Hard Rock</i>	<i>66Dcon</i>	RB: x
		LB: x
<i>RCC Deadman in in Soft or Fractured Hard Rock</i>	<i>67Dcon</i>	RB: x
		LB: x