STRUCTURAL DESIGN REPORT

Consultant:

Loya associates
Consulting Engineers and Project Planners

In association with:

REC Republic Engineering Corporation (Pvt) Ltd.
Consulting Engineers, Planners & Architects

DESIGN CRITERIA FOR STRUCTURAL DESIGN OF BRIDGES, CULVERTS AND RETAINING STRUCTURES OF THE PROJECT

1. GENERAL

For the Design of Reinforced Concrete Post Tensioned bridges spanning 25 Meter, 16 Meter single and multiple and RCC multicell box culverts over various streams/ nullahs crossing the link road, following standards and analysis and methodology is recommended.

2. CODES OF PRACTICE

1.	AASHTO LFRD	American Association of State Highway and Transportation Officials. (Bridge Design Specifications)
2.	WPHC-1967	West Pakistan Highway Code
3.	AISC-LRFD	American institute of steel constructions (For Steel structures)
4.	ACI-318	American Concrete Institute (Building Code requirements for Structural Concrete)

3. UNITS

The following units shall be used for specification, calculation and drawings of the project,

UNITS	SI
Mass	Kg
Force	KN
Length	Meter & Millimeter
Pressure	KN/m^2
Stress	KN/m^2

4. MATERIALS

4.1 Concrete

The following grades of concrete shall be adopted as per NHA standards & Specifications.

Table Concrete Classes

Grade	Minimum 28 days 150mm Cylinder Compressive Strength
A1	21 MPa
A3	28 MPa
D1	34.5 MPa
LEAN	10.34 MPa

4.2 Reinforcement steel

All reinforcement steel bars shall be deformed bars of Grade- 40 and Grade-60 having minimum yield strengths of 276 MPa and 414 MPa confirming to ASTM A615, respectively as mentioned in drawings.

4.3 Prestressing Steel

Steel for Prestressing Strand shall be relaxation Class-1 (Normal relaxation) stress relieved carbon steel manufactured to AASHTO M-203 BS 5895 (or ASTM A416) of Grade -270 having minimum tensile strengths of 1862 Mpa.

5. APPLICATION OF LOADS

5.1 Dead Loads

The dead loads include self-weights of all the structural members and super imposed dead loads wearing course, utilities and barrier.

The self-weight will be generated using the analysis software and the super imposed dead loads will be calculated manually and applied in software on relevant supporting structural elements
Following, unit loads shall be considered while calculating dead loads,

Table Unit Loads

Materials	Unit Load
Concrete (Un – reinforced)	22 KN/m^3
Concrete (Reinforced)	24 KN/m^3
Water	10 KN/m^3
Dry Earth	18 KN/m^3
Compact Earth	20 KN/m^3
Moist Earth	21 KN/m^3
Brick Masonry	19 KN/m^3
Stone Masonry	22 KN/m^3

5.2 Live Loads

The live loads are taken as WPHC Class-A & Class-AA Loading.

5.3 Impact Loads

For Class-A

$I = 15/ (20+L)$

Where, L = Span length in ft

For Class-AA

Varies with Span Length (Refer Code)

5.4 Bridge Super and Sub structures

For Bridge Superstructures, the live loads shall be in accordance with the Class-A and Class-AA of west Pakistan Highway Department Code of Practice (Highway Bridge 1967) and shall be verified by the allowable working stresses of AASHTO LRFD Specifications.

Independent results are obtained for effect of Train Loading plus Dead Loads. Later on, these results are superimposed to have combinations of loads.

Bridge substructure shall be analyzed in longitudinal and transverse direction for different loads combination to evaluate ultimate load for design purpose as per AASHTO LRFD Design Specifications.

5.5 Load combinations

The load combination for Service, Strength and Extreme Event-1 Limit State shall be as per AAHSTO LRFD Design Specifications.

6. SOFTWARE ANALYSIS

SAP-2000 and STAAD-Pro software shall be used for the analysis/ design of bridges. These software are capable of performing analysis and design of structures. These are widely used throughout the world by Consulting Firms for performing Analysis and Design of member under various international codes. These software have built in library of various codes & standards. Calculations and applications of loads have been defined in the detailed calculations.