

TABLE OF CONTENT

Chapter Number	Description	Page
TITLE PAGE		i
APROVAL PAGE.....		ii
FINAL ASSIGNMENT GUIDANCE NEWS.....		ii
PLAGIARISM STATEMENT.....		iv
AUTHENTICITY STATEMENT		v
MOTTO		vi
DEDICATION.....		vii
ACKNOWLEDGEMENT.....		viii
TABLE OF CONTENS		x
LIST OF TABLE		xv
LIST OF FIGURE		xix
LIST OF ABREVITATIONS		xxi
ABSTRACT		xiii

I.....	INTRODUCTIO
N.....	1
1.1 Background.....	1
1.2 Objective of the Study	5
1.3 Problem Limitation	5
1.4 Scope of the Study	5

II.....	LITERATURE
REVIEW	6
2.1 Introduction	6
2.2 Concrete Deck Arch Bridge	6
2.3 Design of Concrete Deck Arch Bridge.....	8
2.3.1 Precast Concrete I Girder Deck Arch Bridge	10
2.3.2 Coloumn	16

2.3.3	Arch	18
2.4	Load	19
2.4.1	Dead Load	20
2.4.2	Additional Dead Load	20
2.4.3	Traffic Load	21
2.4.4	Pedestrian Load	24
2.4.5	Wind Load	25
2.4.6	Earthquake Load	26
2.5	Summary of the literature	28

III.....	DESIGN AND	
METHODOLOGY	29	
3.1	Introduction	29
3.2	Preliminary Design	29
3.3	Design of Upper Stucture	32
3.3.1	Determining Girder	32
3.3.2	Select Materials	32
3.3.3	Calculate Section Properties	33
3.3.4	Precast Section	34
3.3.5	Effective Flange Width	35
3.3.6	Composite Section	35
3.3.7	Design of Deck slab	35
3.3.8	Design Arch	36
3.3.9	Coloum Analysis and Design	37
3.4	Precast Concrete I Girder Loading	40
3.4.1	Resume moments and shear force on a Precast Concrete I Girder ...	40
3.4.2	Prestress forces, Exentrivity, and Number of Tendon	40
3.4.3	Initial Conditions when stress transferred to the fiber	41
3.4.4	Final Conditions after transfer	44
3.4.5	Tendon position	45
3.5	Precast Concrete I Girder Deflection.....	48
3.5.1	Deflection in the initial state (transfer).....	48

3.5.2	Deflection after loss of prestress	49
3.5.3	PCI Deflection due to Load	50
3.5.3.1	Deflection due to Self Weight	50
3.5.3.2	Deflection due to Superimposed Dead Load.....	50
3.5.3.3	Deflection due to Prestress	50
3.5.3.4	Deflection due to Creep and Shringke.....	51
3.5.3.5	Deflection due to Line Load.....	51
3.5.3.6	Deflection due to Brake Force.....	52
3.5.3.7	Deflection due to Temperature	52
3.5.3.8	Deflection due to Wind Load	52
3.5.3.9	Deflection due to Earthquake Load	53
3.5.3.10	Deflection Control to Load Combinations	53
3.5.3.11	Ultimate review of I girder prestress	53
3.5.4	Prestress Concrete I Girder Reinforcement.....	58

IV	DESIGN AND CALCULATION.....	60
4.1	Introduction	60
4.2	Preliminary Design	60
4.3	Calculation.....	61
4.3.1	Determination PCI Girder Data.....	61
4.3.1.1	Loading Prestressed Beam.....	70
4.3.1.2	Additional dead load (ADL).....	72
4.3.1.3	“D” Lane load (LL)	73
4.3.1.4	Brake Force.....	75
4.3.1.5	Wind Load	77
4.3.1.6	Earthquake Load.....	79
4.3.1.7	Resume Load	81
4.3.2	Prestressing force, eccentricity and number of tendon.....	86
4.3.2.1	Initial Conditional (Transfer).....	86
4.3.2.2	Final condition.....	87
4.3.3	Construction of Prestressed Beams	89

4.3.4	Tendon Position.....	90
4.3.4.1	Tendon position in the middle pedestal.....	90
4.3.4.2	Tendon position in pedestal	91
4.3.4.3	Eccentricity each tendon	93
4.3.5	Core track tendon (Cable).....	94
4.3.5.1	Angel anchor.....	94
4.3.5.2	Layout and trace cable	95
4.3.5.3	Use of anchor.....	98
4.3.6	Loss of prestress on cable	98
4.3.6.1	Anchorage friction	98
4.3.6.2	Jack Friction	99
4.3.6.3	Elastic Shortening.....	100
4.3.6.4	Anchoring	102
4.3.6.5	Loss caused stress relaxation of tendon.....	103
4.3.7	The stress occurs in the cross section of the beam	107
4.3.7.1	Initial state (during transfer)	107
4.3.7.2	Circumstances after loss of prestress.....	108
4.3.7.3	State after plate floor finished in cor (young concrete)	109
4.3.7.4	Condition after the beam becomes composite	109
4.3.8	Stresses that occur in composite beams.....	110
4.3.8.1	Stresses due tp own weight (MS)	110
4.3.8.2	Load due to additional stress (MA)	111
4.3.8.3	Stress due to shrinkage and creep (SR)	112
4.3.8.4	Stress due to prestressing (PR)	115
4.3.8.5	Stress due to lane load (TD)	116
4.3.8.6	Stress due to the brake force (TB)	116
4.3.8.7	Stress due to wind load (EW)	117
4.3.8.8	Stress due to earthquake load (EQ)	118
4.3.9	Stress due to the influence of temperature.....	118
4.3.10	Tension controls on loading combination	120
4.3.11	Reinforcement of End Block	123
4.3.11.1	Static Momen of Beam.....	124

4.3.11.2	Calculation for Froce Bursting	125
4.3.11.3	Review of Shear.....	128
4.3.11.4	Cross bar distance used.....	133
4.3.11.5	Calculation Shear Conector	134
4.3.12	Deflection on the prestress beam (before composite)	137
4.3.12.1	Deflection in the initial state(transfer).....	137
4.3.12.2	Deflection after loss of prestress	137
4.3.12.3	Deflection after ends casted.....	138
4.3.12.4	Deflection after plate and beam become composite.....	139
4.3.12.5	Deflection on composite beam	139
4.3.12.6	Deflection due to self weight.....	140
4.3.12.7	Deflection additional dead load.....	140
4.3.12.8	Deflection due to prestress	140
4.3.12.9	Deflection shrinkage and crawl	140
4.3.12.10	Deflection lane load.....	141
4.3.12.11	Deflection brake force	141
4.3.12.12	Deflection temperature	141
4.3.12.13	Deflection wind load	142
4.3.12.14	Deflection eqarthquake load.....	142
4.3.13	Reviews Ultimate Beam Prestress	144
4.3.13.1	Ultimate Moment Capacity	144
4.3.14	Ultimate moment on beam	146
4.3.14.1	Moment due to shrinkage and crawl.....	146
4.3.14.2	Moment due to the influence of temperature.....	147
4.3.14.3	Moment due to prestress.....	147
4.4	Modeling Brige on SAP2000	151
4.4.1	Moedling on SAP2000	151
4.4.2	Input Load.....	151
4.4.3	Result data SAP2000	153
4.4.3.1	Result Precast I Girder on SAP2000	154
4.4.3.2	Result Coloumn	155

V.....	CONCLUSIONS AND RECOMMENDATIONS.....	157
5.1	Conclusions	158
5.2	Recommendations	159
REFERENCES.....		152
APPENDIX		153

LIST OF TABLE

Table Number	Description Table	Page
2.1	Selfweight load factor.....	20
2.2	Load factor for additional dead loads	21
2.3	Load factor due to "D" lane load	22
2.4	of load factors due to loading of truck "T"	23
2.5	load factors due to brake force	24
2.6	Load factor table for pedestrians	24
2.7	Cw drag coefficient	25
2.8	Wind speed plan Vw.....	25
2.9	load factors of wind loads.....	25
2.10	load factors for earthquake loads.....	27
2.11	of Interest Factors	27
2.12	Table of building type factors.....	28
3.1	Formula for calculated of maximum moment	40
3.2	Seven wire strands	42
4.1	Bridge Data.....	60
4.2	Material Structure	61
4.3	Specific Gravity	61
4.4	Data Precast Concrete I Girder	62
4.5	Spesific Gravity	62
4.6	Prestress Beam Dimensions.....	62
4.7	Concrete data	62
4.8	Pressure Permission	63
4.9	Prestress Steel	63
4.10	Reinforcement steel	64
4.11	Section Propertise beam	66
4.12	Section propertise composit.....	68
4.13	Diaphragm Data.....	70

4.14	Beam data	71
4.15	Shear force and moment Dead Load	72
4.16	Additional dead load.....	73
4.17	Brake force	76
4.18	Resume Moment.....	82
4.19	Moment Prestress beam.....	83
4.20	Shear Force Prestress Beam	84
4.21	Properties data	86
4.22	Strand cable data.....	87
4.23	Strands tendon	88
4.24	Reinforcement bar	89
4.25	strands tendon	90
4.26	Stands Tendon	92
4.27	The static moment of the tendon	92
4.28	Eccentricity Tendon	93
4.29	Track Tendon.....	94
4.30	Core Track Tendon data	94
4.31	Angle Anchor	95
4.32	Trace Cable data.....	95
4.33	Position of Cable	96
4.34	Position each cable	97
4.35	Anchoring data	102
4.36	Shrinkage data	103
4.37	Creep data.....	104
4.38	Loss Prestress	106
4.39	Initial State data.....	107
4.40	Circumstances data.....	108
4.41	After Gloor Finished data.....	109
4.42	4. Beam Becomes Composite data	109
4.43	Additional Stress data.....	111
4.44	Concrete Shrinkage data.....	112
4.45	Concrete Creep data.....	113

4.46	Resume Concrete Creep	114
4.47	Shrinkage Superposition.....	114
4.48	Due prestressing data.....	115
4.49	Lane Load Stress data.....	116
4.50	Brake Force Stress data	116
4.51	Wind Load Stress data.....	117
4.52	Earthquake load Stress data	118
4.53	Stress Influence Temperature data	118
4.54	Stress Influence Temperature Output	119
4.55	Eccentricity Output	119
4.56	Resume Combination Load	120
4.57	Tension control of combination 1.....	121
4.58	Tension control of combination 2.....	121
4.59	Tension control of combination 3.....	121
4.60	Tension control of combination 4.....	122
4.61	Tension control of combination 5.....	122
4.62	Reinforcement data.....	123
4.63	Static Moment upper section	124
4.64	Static Moments Lower Section.....	124
4.65	Cross bar Vertical Direction Output.....	127
4.66	Cross Bar Horizontal Direction	127
4.67	Number Cros bar brusting	128
4.68	Review shear above neutral line	131
4.69	Review shear below neutral line.....	132
4.70	Cross Bar distance	133
4.71	Shear conector data.....	134
4.72	Calculation distance shear conector	136
4.73	Modulus of elasticity beam.....	137
4.74	4. initial prestressing force.....	137
4.75	final prestressing force.....	137
4.76	composit moment beam.....	138
4.77	Composite beam data.....	139

4.78	Composite beam data.....	139
4.79	Composite beam data.....	140
4.80	Load to SAP.....	153

LIST OF FIGURE

Figure Number	Description of Figure	Page
1.1	Simple Bridge Construction	2
1.2	Concrete Deck Arch Bridge	3
1.3	Steel Deck Arch Bridge.....	3
1.4	Suspension Bridge	4
1.5	Cable Stayed Bridge	4
2.1	Original Arch Bridge	7
2.2	Truss Arch Bridge	8
2.3	Design Deck Arch Bridge.....	9
2.4	Figure 2. 4 Cross section	11
2.5	Concrete Arch Bridge.....	17
2.6	Calculation of arch.....	19
2.7	The "D" load distribution works on the bridge.....	22
2.8	The "T" Provisions are Worked on the Highway Bridge	23
3.1	Flowcharts	30
3.2	Precast Concrete I Girder	34
3.3	Solid Shaft Pier Examples	38
3.4	Single and Double Bearing Piers.....	38
3.5	Description of Back-on-Line and Ahead-on-Line.....	39
3.6	Skew Conventions	39
4.1	Numbering Precast Concrete I Girder	63
4.2	Effective width plate floor.....	64
4.3	Section Properties of beam.....	66
4.4	Composit Beam	68
4.5	Lane Load	74
4.6	Brake Force.....	76
4.7	Wind Load	78

4.8	Initial condition.....	86
4.9	reinforcement beam	90
4.10	Track Tendon.....	95
4.11	Trace Cable position.....	96
4.12	Trace Cable Position.....	97
4.13	Anchor	98
4.14	Initial State.....	107
4.15	Stress due to pressing	115
4.16	reinforcement end block	123
4.17	Moment Static Beam	124
4.18	Bursting	125
4.19	Bursting Position	128
4.20	Cross bar Distance	133
4.21	Shear conector	134
4.22	Moment Capacity	144
4.23	Tendon layout and precast concrete I girder Reinforcement.....	150
4.24	Modeling Deck Arch Bridge on SAP2000.....	151
4.25	Input Distributed Load in SAP 2000	151
4.26	Input Lane Load in SAP2000	152
4.27	Input Wind Load in SAP2000	152
4.28	Result Axial Force at SAP2000.....	153
4.29	Result Moment Force at SAP2000	154
4.30	Result Shear Force at SAP2000.....	154
4.31	Result Deflection PCI at SAP2000.....	154
4.32	Result Axial Force Coloumn SAP2000.....	155
4.33	Result Momentl Force Coloumn SAP2000	155
4.34	Axial and Moment Force coloumn	156

LIST OF ABBREVIATION

Ac	: Composite beam cross section area
I _{c0}	: Momen inertia
Y _{ac}	: Center of gravity location a
Y _{bc}	: Center of gravity location b
h _o	: Total height composite beam
y	: Distance to base
M _{dg}	: Maximum moment
Pi	: Load
S	: Cross section modulus
A _g	: Cross-sectional area
M	: Maximum moment
P	: Load
S	: Cross section modulus
I	: Moment inertia
A	: Cross-sectional area
E	: Elasticity modulus
W _c	: Specific gravity concrete
F _c	: Concrete compressive strength (Mpa)
E	: Elastic modulus of concrete plate (Mpa)
n	: Comparison of elastic
B _{eff}	: the width of the replacement concrete (m)
A	: cross section of prestressed beams
y	: Center of gravity
h	: total prestressed beam height (m)
P _{n(max)}	: Maximum axial load
h	: Total Height
f'c	: Concrete compressive strength
A _{gr}	: Melting strength
e _t	: Exsentrisitas
P _u	: Ultimate cross section

P_n (max)	: Maximum axial load
A_g	: Section area of column
A_{st}	: $1.5\% \times A_g$
f'_c	: Concrete compressive strength
f_y	: Yielding strength
P_u	: Ultimate cross section
H_{ki}	: critical horizontal component of the arch normal force [kN]
N_{ki}	: critical normal force of the arch [kN]
q	: uniform distributed arch loading [kN/m]
l	: span length [m]
f	: height of the arch [m]
s	: half of the arch length [m]
j	: angle between arch and deck
a	: coefficient depending on number of hangers and ratio on f/l [-]
b	: effective length factor (buckling factor); depending on parameters like number of hangers
b	: plate width
d	: concrete covers
f'_y	: Concrete quality
C_w	: drag coefficient
V_w	: planned wind speed (m/sec)
TEW	: Ultimate force wind load (kN)
A_b	: coefficient area on the side of the bridge (m^2)
$C_{elastis}$: basic shear coefficient without ductility and risk factor (Z)
$C_{plastis}$: Basic shear coefficients including ductility and risk factors
A	: Peak acceleration (PGA) in bedrock
R	: Bedrock response
Z	: reduction factor in relation to tenacity and risk
$T'EQ$: Base shear force in the direction being reviewed (Kn)
K_h	: Coefficient of horizontal earthquake load
K_v	: coefficient of vertical earthquake load

I	: interest factor
C	: basic shear coefficient
S	: Building type factor
WT	: Total nominal weight of the building including additional dead load.
g	: Gravity acceleration (m / s)
KP	: Stiffness of the joint as a horizontal force needed to make the deflection unit at the top of the pier (kN / m)
Ds	: Structure Depth
L	: Span Length
Eci	: modulus of elasticity of concrete at time of transfer At 28 days
F'c	: compressive strength of concrete
A_g	: gross area of girder section (in. ²)
I_g	: gross moment of inertia of girder about centroidal axis (in. ⁴)
y_b	: distance from neutral axis to extreme bottom fiber of PC girder
y_t	: distance from neutral axis to extreme top fiber of PC girder (in.)
S_b	: section modulus for bottom extreme fiber of section (in. ³)
S_t	: section modulus for top extreme fiber of section (in. ³)
r	: radius of gyration (in.)
S	: spacing of girders or webs (ft)
L	: individual span length (ft)
Pt	: In the bottom prestress at the initial condition (kN)
e _s	: Exentrisitas tendon
Wa	: Section Propertise beam
A	: Area (m ²)
P _o	: Percentage of yield stress arising on steel (%)
n _s	: Number of strands
P _{bs1}	: A single drop of tendon (Kn)
y _d	: Position of tendon in the middle of the span (m)
z _o	: Distance from base to trajectory of core at center of span (m)
a	: Set (m)
n _s	: Number of strands

a'	: Position of the tendon at the pedestal (m)
y_b	: The center of gravity to the bottom of girder (m)
y_d'	: Set (m)
Y	: Tendon trajectory (m)
f	: Eccentricity (m)
Ω	: Track gauge (m)
L	: Long (m)
Q_{pt}	: Total prestress force in the initial (kN/m)
P_t	: Prestress force in the initial (kN)
e_s	: The distance of the weight of tendon to te center (m)
L	: Long span of girder (m)
M_{bs}	: Maksimum moment in the middle of the span (kNm)
Q_{bs}	: Self weigh of girder (kN/m ³)
L	: Long span of girder (m)
δ_1	: Deflection at the initial state
Q_{pt}	: Total prestress force in the initial (kN/m)
Q_{bs}	: Self weigh of girder (kN/m ³)
L	: Long span of girder (m)
E_c	: Elastic modulus of concrete (kPa)
I_x	: Moment of inertia to the line weight of girder (m ⁴)
Q_{peff}	: Total prestress force in the end (kN/m)
P_{eff}	: Prestress force in the end (kN)
e_s	: The distance of the weight of tendon to the center (m)
L	: Long span of girder (m)