Assignment 1 (CE 414)-Solution

Q1: A 15 x 36 inch prestressed concrete beam is loaded by a uniform load of 3.65 k/ft on 25 ft long span. The prestressing tendon is located at 8 in above the bottom fibre and produces an effective prestress of 400 kip. Compute the fibre stresses in the concrete at the mid-span section by the concept of transforming concrete into an elastic material.

Elastic Material Concept (FPS Unit)

Solution:

L=	25	ft	self weight=	0.5625	kip/ft
b=	15	in	w=	4.2125	kip/ft
d=	36	in	A=	540	sqin
F=	400	k	I =	58320	in^4
e= 36/2-8	10	in	M=	329.102	k-ft
applied load=	3.65	k/ft	**Top fibre stress, ft =**	**-725.07**	psi
			Bottom fibre stress, fb =	**-756.41**	psi

Q2: Compute the fibre stresses in the concrete at the mid-span section by the concept of load balancing for a 5.5 m long prestressed concrete beam with 50 x 110 cm cross sectional dimension. The beam is loaded by a uniform load of 45 kN/m. The prestressing tendon is located at 90 cm below from the top fibre and produces an effective prestressing force of 1500 kN.
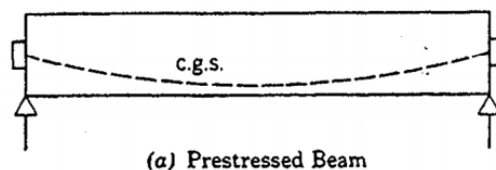
Load Balancing Concept (SI Unit)

Solution:

L=	5.5	m	A=	550000	mm^2
b=	500	mm	I =	5.546E+10	mm^4
d=	1100	mm	wb=	166.612	kN/m
F=	1800	kN	w-wb =	-107.862	kN/m
sag, h= (90-110/2)*10	350	mm	M=	-407.852	kN-m
applied load=	45	kN/m			
self weight=	13.75	kN/m	**Top fibre stress, ft =**	**0.772**	**MPa**
So, w=	58.75	kN/m	**Bottom fibre stress, fb =**	**-7.318**	**MPa**

Q3: A 30 ft long and 20 x 40 inch prestressed concrete beam is loaded by a uniform load of 4.50 k/ft. The prestressing tendon is located at 7 in below from the c.g.c. and produces an effective prestress of 500 psi. Compute the fibre stresses in the concrete at the mid-span section by the concept of internal resisting couple.

Internal resisting couple Concept (FPS Unit)

Solution:			A=		800	in^2	
L=	30	ft	I =		106666.667	in^4	
b=	20	in	M=		600	k-ft	
d=	40	in	F=Stress x A		400	kip	
Stress=	500	psi	lever arm, a=		18.00	in	
e=	7	in	Position of C =		31.00	in	from bottom fibre
applied load=	4.5	k/ft	Position of C =		11.00	in	from c.g.c.
self weight	0.8333	k/ft	**Top fibre stress, ft =**		**-1325.000**	**psi**	
So, w=	5.3333	k/ft	**Bottom fibre stress, fb =**		**325.000**	**psi**	

Q4: A prestressed concrete member beam 600 mm x 1200 mm has a simple span of 8 m. The beam is loaded by a uniform load of 50_kN/m including its own weight. The prestressing tendon is located at 250 mm above the bottom surface and produces an effective prestress of 1700 kN. Compute the fibre stresses in the concrete at the mid-span section by the concept of transforming concrete into an elastic material.

(a) Prestressed Beam

Elastic Material Concept (SI Unit)

Solution:						
L=	8	m	A=		720000	mm^2
b=	600	mm	I =		8.64E+10	mm^4
d=	1200	mm	M=		400.000	kN-m
F=	1700	kN				
e= 1200/2-250	350	mm	**Top fibre stress, ft =**		**-1.01**	**MPa**
W =	50	kN/m	**Bottom fibre stress, fb =**		**-3.72**	**MPa**
(here, load is given including self-weight)						