§ 8. SHEAR

1. CALCULATION OF THE PRINCIPAL TENSILE STRESS

SHEAR STRESS

$$\tau = \frac{S\,Q}{B\,I}$$

WHERE S: SHEAR FORCE (S - Sp)

Q: GEOMETRICAL MOMENT OF AREA

B: WIDTH OF WEB

I: MOMENT OF INERTIA OF AREA

THE PRINCIPAL TENSILE STRESS

$$\sigma_i = 1/2\left(\sigma_c - \sqrt{\sigma_c^2 + 4\tau^2}\right)$$

SHEAR FORCE DUE TO PRESTRESS

$$Sp = Pe \sin\alpha$$

(t)

	Pe	$\Sigma \sin\alpha$	$Pe \sin\alpha$
SEC - 0	35.34	1.4634	51.7
SEC - 1	36.24	0.2309	8.4
SEC - 2	36.43	0	0
SEC - 3	37.62	0	0
SEC - 4	37.00	2.1613	73.5
SEC - 5	27.76	0	0

	AT WORKING LOAD		AT ULTIMATE LOAD	
	S	$S - Sp$	S'	$S' - Sp$
SEC - 0	35.8	——	60.6	8.9
SEC - 1	17.3	8.9	30.1	21.7
SEC - 2	4.1	4.1	8.2	8.2
SEC - 3	20.9	20.9	35.8	35.8
SEC - 4	38.2	——	64.2	——
SEC - 5	56.3	56.3	94.4	94.4

SEC - (3)

SHEAR STRESS

AT WORKING LOAD (AT THE CENTROID OF SECTION)

$$\tau = \frac{20\,900 \times 121\,380}{40 \times 24\,177\,700} = 2.6 \text{ kg/cm}^2$$

AT ULTIMATE LOAD (AT THE CENTROID OF SECTION)

$$\tau = \frac{35\,800 \times 121\,380}{40 \times 24\,177\,700} = 4.5 \text{ kg/cm}^2$$

THE PRINCIPAL TENSILE STRESS

AT WORKING LOAD

$$\sigma_i = 1/2 \times (55.2 - \sqrt{55.2^2 + 4 \times 2.6^2})$$

$$= -0.1 \text{ kg/cm}^2$$

AT ULTIMATE LOAD

$$\sigma_i = 1/2 \times (55.3 - \sqrt{55.3^2 + 4 \times 4.5^2})$$

$$= -0.4 \text{ kg/cm}^2$$

SEC - (5)

SHEAR STRESS

AT WORKING LOAD

(AT THE CENTROID OF THE SECTION)

$$\tau = \frac{56\,300 \times 163\,480}{60 \times 27\,506\,900} = 5.6 \quad kg/cm^2$$

AT ULTIMATE LOAD

(AT THE CENTROID OF THE SECTION)

$$\tau = \frac{94\,400 \times 163\,480}{60 \times 27\,506\,900} = 9.4 \quad kg/cm^2$$

(AT THE POINT WHERE BENDING STRESS IS 0.)

$$\tau = \frac{94\,400 \times 275\,070}{60 \times 27\,506\,900} = 15.7 \quad kg/cm^2$$

THE PRINCIPAL TENSILE STRESS

AT WORKING LOAD

$$\sigma_t = 1/2 \times (39.1 - \sqrt{39.1^2 + 4 \times 5.6^2})$$

$$= -0.9 \quad kg/cm^2$$

AT ULTIMATE LOAD

$$\sigma_i' = 1/2 \times (34.1 - \sqrt{34.1^2 + 4 \times 3.4^2})$$

$$= -2.4 \quad kg/cm^2$$

$$\sigma_i = -25.7 \quad kg/cm^2$$

2. SHEAR REINFORCEMENT

SHEAR REINFORCEMENT

$$A_w = \frac{S' a}{\sigma_s d}$$

WHERE S' = SHEAR FORCE

a = THE SPACING OF STIRRUPS

σ_s = THE TENSILE STRESS IN THE SHEAR REINFORCEMENT

$= 0.8\, \sigma_{sy}$

d = THE ARM OF THE RESISTANT MOMENT

NOMINAL SHEAR REINFORCEMENT

$$A_{wn} = 0.0012\, b\, a$$

WHERE b = THE BREADTH OF RIB

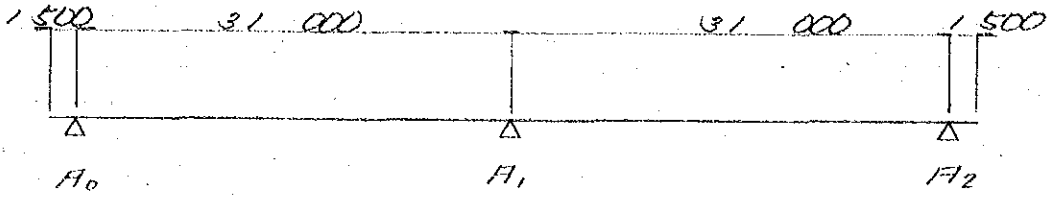
a = THE SPACING OF STIRRUPS

SHEAR REINFORCEMENT PER METER

	Aw	b	Awn	use Aw
SEC-0	—	300	3.60	2-φ12(12.5"c/c) = 18.10
SEC-1	—	200	2.40	"
SEC-2	—	200	2.40	2-φ12(25.0"c/c) = 9.05
SEC-3	—	200	2.40	"
SEC-4	—	200	2.40	"
SEC-5	—	300	3.60	"

§§ 3. REACTION

§ 1. REACTION



		R0, R2	R1
DEAD	I	31.46	88.51
DEAD	II	1.94	5.74
LIVE LOAD	MAX	12.94	35.26
	MIN	- 0.99	0
TOTAL	MAX	46.34	129.51
	MIN	32.41	94.25