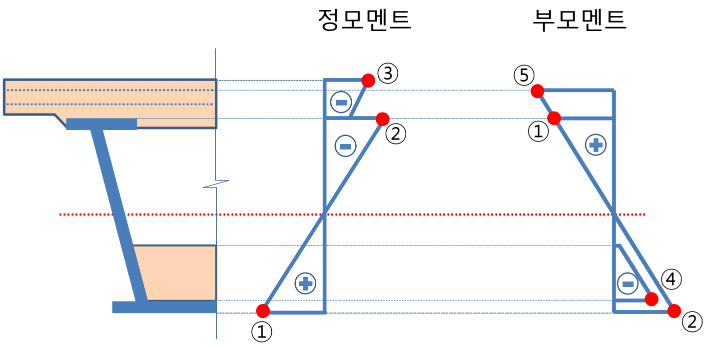
7	단 면 검 토

7.2. 강도한계상태

(☞ 강.설 4.3.3.2.6)

검토내용

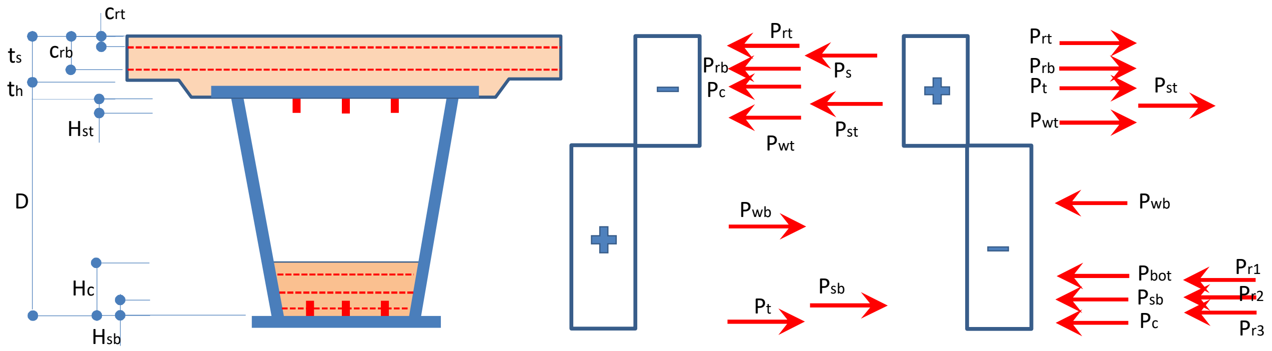
연성요		
	$D_p \le 0.42D_t$	*(강.설 4.3-158)*
콘크리트		
	$f_{deck} \le 0.6f'_c$	*(강.설 4.3.3.2.7.2)*
	$f_{bot\ con'c} \le 0.6f'_c$	
Flexure (Non-compact section)		*(강.설 4.3-254)*
압축플랜지	$f_{bu} \le \Phi_f F_{nc}$	*(강.설 4.3-255)*
인장플랜지	$f_{bu} \le \Phi_f F_{nt}$	
Flexure (Compact section)		
	$M_u \le \Phi_f M_n$	*(강.설 4.3-253)*
웨브		
	$V_{ui} \le \Phi_v V_n$	*(강.설 4.3-179)*



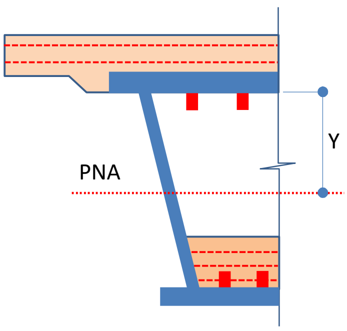
- ① = fbu 플랜지 인장응력
- ② = fbu 플랜지 압축응력
- ③ = fdeck 바닥판 압축응력
- ④ = fbot 내부 con'c 압축응력
- ⑤ = fs 철근 인장응력

(☞ 강.설 B.1)

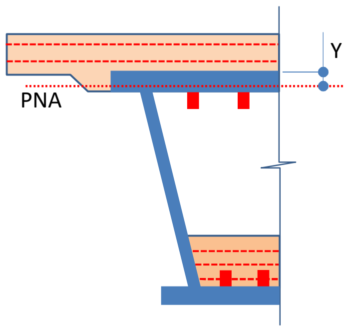
7.2.1. Y_{PNA}, M_P for plastic moment 산정



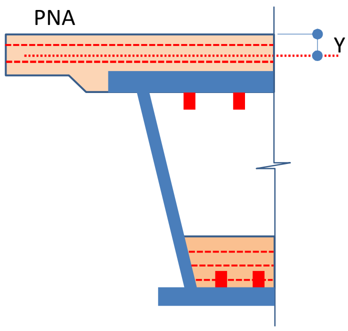
P_t	=	$F_{yt}b_tt_t$	Tension flange
P_c	=	$F_{yc}b_ct_c$	Compression flange
P_w	=	$2F_{yw}(D/\cos\Phi)t_w$	Web
P_{con}	=	$0.85f'_cA_{con}$	Bottom concrete
P_s	=	$0.85f'_cb_st_s$	Deck concrete
P_{rt}	=	$F_{yrt}A_{rt}$	Top rebar in deck slab
P_{rb}	=	$F_{yrb}A_{rb}$	Bottom rebar in deck slab
P_{st}	=	$F_{yst}A_{st}$	Top Rib
P_{sb}	=	$F_{ysb}A_{sb}$	Bottom Rib
$\sum P_r$	=		Total area of rebar in bottom concrete
$t_{s,}$ t_h	=		deck slab and haunch 두께
D	=		web depth
H_{st}, H_{sb}	=		Top rib and bottom rib depth
C_{rt} C_{rb}	=		Distance from top deck slab to top the centerline of top / bottom layer reb
H_c	=		내부 con'c depth
dr	=	Hc/2	Distance from bottom concrete rebar to PNA



Case 1, 8, a, b, c, d



Case 2, 9



Case 3, 4, 5, 6, 7

1) 일반 Cases

- **정모멘트**

Location	조건 / Y_{PNA} / M_P	Distance from Y_{PNA} to mems
(1)	In Web	$d_c = Y + t_c/2$
조건	$P_t + P_{sb} + (D-2H_{st})P_w/D + \sum P_r \geq P_{st} + P_c + P_s + P_{rb} + P_{rt}$	$d_t = D - Y + t_t/2$
		$d_{sb} = D - Y - H_{sb}/2$
Y_{PNA} =	$D/2\ [(P_t + P_{sb} + \sum P_r - P_{st} - P_c - P_s - P_{rb} - P_{rt}) / P_w + 1]$	$d_{st} = Y - H_{st}/2$
		$d_s = Y + t_h + t_s/2$
M_p =	$P_w / 2 / D\ [Y^2 + (D-Y)^2] + P_c d_c + P_{sb} d_{sb} + P_{st} d_{st} + P_t d_t + P_s d_s + P_{rb} d_{rb}$	$d_{rb} = Y + th + t_s - c_{rb}$
	$+ P_{rt} d_{rt} + \sum P_r d_r$	$d_{rt} = Y + t_h + t_s - c_{rt}$
		$d_r = D - Y - H_c/2$
(2)	In Top Flange	$d_t = t_c - Y + D + t_t/2$
조건	$P_t + P_{sb} + \sum P_r + P_w + P_{st} + P_c \geq P_s + P_{rb} + P_{rt}$	$d_w = t_c - Y + D/2$
		$d_{st} = t_c - Y + H_{st}/2$
Y_{PNA} =	$t_c/2\ [(P_t + P_{sb} + \sum P_r + P_w + P_{st} - P_s - P_{rb} - P_{rt}) / P_c + 1]$	$d_{sb} = t_c - Y + D - H_{sb}/2$
		$d_s = t_s/2 + t_h - t_c + Y$
M_p =	$P_c / 2 / t_c\ [Y^2 + (t_c - Y)^2] + P_t d_t + P_{sb} d_{sb} + P_{st} d_{st} + P_s d_s + P_{rb} d_{rb}$	$d_{rb} = t_s - c_{rb} + t_h - t_c + Y$
	$+ P_{rt} d_{rt} + \sum P_r d_r$	$d_{rt} = t_s - c_{rt} + t_h - t_c + Y$
		$d_r = t_c - Y + D - H_c/2$
(3)	Below P_{rb}	$d_c = t_s + t_h - Y - t_c/2$
조건	$P_t + P_{sb} + \sum P_r + P_w + P_{st} + P_c \geq (c_{rb}/t_s)P_s + P_{rb} + P_{rt}$	$d_t = t_s + t_h - Y + D + t_t/2$
		$d_w = t_s + t_h - Y + D/2$
Y_{PNA} =	$t_s\ (P_t + P_{sb} + \sum P_r + P_w + P_{st} + P_c - P_{rb} - P_{rt}) / P_s$	$d_{st} = t_s + t_h - Y + H_{st}/2$
		$d_{sb} = t_s + t_h - Y + D - H_{sb}/2$
M_p =	$(Y^2 / 2 / t_s)\ P_s + P_c d_c + P_{sb} d_{sb} + P_{st} d_{st} + P_w d_w + P_t d_t + P_{rb} d_{rb}$	$d_{rb} = Y - c_{rb}$
	$+ P_{rt} d_{rt} + \sum P_r d_r$	$d_{rt} = Y - c_{rt}$
		$d_r = t_s + t_h - Y + D - H_c/2$
(4)	At P_{rb}	$d_c = t_s + t_h - Y - t_c/2$
조건	$P_t + P_{sb} + \sum P_r + P_w + P_{st} + P_c + P_{rb} \geq (c_{rb}/t_s)P_s + P_{rt}$	$d_t = t_s + t_h - Y + D + t_t/2$
		$d_w = t_s + t_h - Y + D/2$
Y_{PNA} =	c_{rb}	$d_{st} = t_s + t_h - Y + H_{st}/2$
		$d_{sb} = t_s + t_h - Y + D - H_{sb}/2$
M_p =	$(Y^2 / 2 / t_s)\ P_s + P_c d_c + P_{sb} d_{sb} + P_{st} d_{st} + P_w d_w + P_t d_t + P_{rt} d_{rt} + \sum P_r d_r$	$d_{rt} = Y - c_{rt}$
		$d_r = t_s + th - Y + D - H_c/2$
(5)	Above P_{rb}	$d_c = t_s + t_h - Y - t_c/2$
조건	$P_t + P_{sb} + \sum P_r + P_w + P_{st} + P_c + P_{rb} \geq (c_{rt}/t_s)P_s + P_{rt}$	$d_t = t_s + t_h - Y + D + t_t/2$
		$d_w = t_s + t_h - Y + D/2$
Y_{PNA} =	$t_s\ (P_t + P_{sb} + \sum P_r + P_w + P_{st} + P_c + P_{rb} - P_{rt}) / P_s$	$d_{sb} = t_s + t_h - Y + D - H_{sb}/2$
		$d_{st} = t_s + t_h - Y + H_{st}/2$
M_p =	$(Y^2 / 2 / t_s)\ P_s + P_c d_c + P_{sb} d_{sb} + P_{st} d_{st} + P_w d_w + P_t d_t + P_{rb} d_{rb}$	$d_{rb} = c_{rb} - Y$
	$+ P_{rt} d_{rt} + \sum P_r d_r$	$d_{rt} = Y - c_{rt}$
		$d_r = t_s + t_h - Y + D - H_c/2$
(6)	At P_{rt}	$d_c = t_s + t_h - Y - t_c/2$
조건	$P_t + P_{sb} + \sum P_r + P_w + P_{st} + P_c + P_{rb} + P_{rt} \geq (c_{rt}/t_s)P_s$	$d_t = t_s + t_h - Y + D + t_t/2$
		$d_w = t_s + t_h - Y + D/2$
Y_{PNA} =	c_{rt}	$d_{sb} = t_s + t_h - Y + D - H_2/2$
		$d_{st} = t_s + t_h - Y + H_1/2$
M_p =	$(Y^2 / 2 / t_s)\ P_s + P_c d_c + P_{sb} d_{sb} + P_{st} d_{st} + P_w d_w + P_t d_t + P_{rb} d_{rb} + \sum P_r d_r$	$d_{rb} = c_{rb} - Y$

		$d_r = t_s + t_h - Y + D - H_c/2$
(7)	Above P_{rt}	$d_c = t_s + t_h - Y - t_c/2$
조건	$P_t + P_{sb} + \sum P_r + P_w + P_{st} + P_c + P_{rb} + P_{rt} < (c_{rt}/t_s)P_s$	$d_t = t_s + t_h - Y + D + t_t/2$
		$d_w = t_s + t_h - Y + D/2$
Y_{PNA} =	$t_s (P_t + P_{sb} + \sum P_r + P_w + P_{st} + P_c + P_{rb} + P_{rt}) / P_s$	$d_{sb} = t_s + t_h - Y + D - H_{sb}/2$
		$d_{st} = t_s + t_h - Y + H_{st}/2$
M_p =	$(Y^2 / 2 / t_s) P_s + P_c d_c + P_{sb} d_{sb} + P_{st} d_{st} + P_w d_w + P_t d_t + P_{rb} d_{rb}$	$d_{rb} = c_{rb} - Y$
	$+ P_{rt} d_{rt} + \sum P_r d_r$	$d_{rt} = c_{rt} - Y$
		$d_r = t_s + t_h - Y + D - H_c/2$

- **부모멘트**

Location	**조건 / YPNA / MP**	**Distance from Y_{PNA} to mems**
(8)	In Web	$d_c = D - Y + t_c/2$
조건	$P_c + P_{sb} + \sum P_r + P_{con} + (D-H_{st})P_w/D \geq P_{st} + P_t + P_{rb} + P_{rt}$	$d_t = Y + t_t/2$
		$d_{st} = Y - H_{st}/2$
Y_{PNA} =	$D/2\ [(P_c + P_{sb} + \sum P_r + P_{con} - P_{st} - P_t - P_{rb} - P_{rt}) / P_w + 1]$	$d_{sb} = D - Y - H_{sb}/2$
		$d_{rb} = Y + t_h + t_s - c_{rb}$
M_p =	$P_w / 2 / D\ [Y^2 + (D - Y)^2] + P_{con} d_{con} + P_c d_c + P_{sb} d_{sb} + P_{st} d_{st} + P_t d_t + P_{rb} d_{rb}$	$d_{rt} = Y + t_h + t_s - c_{rt}$
	$+ P_{rt} d_{rt} + \sum P_r d_r$	$d_{con} = D - Y - H_c/2$
		$d_r = D - Y - H_c/2$
(9)	In Top Flange	$d_c = t_t - Y + D + t_c/2$
조건	$P_c + P_{sb} + \sum P_r + P_{con} + P_w + P_{st} + P_t \geq P_{rb} + P_{rt}$	$d_w = t_t - Y + D/2$
		$d_s = t_s/2 + t_h - t_t + Y$
Y_{PNA} =	$t_t/2\ [(P_c + P_{sb} + \sum P_r + P_{con} + P_{st} + P_w - P_{rb} - P_{rt}) / P_t + 1]$	$d_{sb} = t_t - Y + D - H_{sb}/2$
		$d_{st} = t_t - Y + H_{st}/2$
M_p =	$P_t / 2 / t_t\ [Y^2 + (t_t - Y)^2] + P_{con} d_{con} + P_c d_c + P_{sb} d_{sb} + P_{st} d_{st} + P_w d_w + P_{rb} d_{rb}$	$d_{rb} = t_s + t_h - c_{rb} - t_t + Y$
	$+ P_{rt} d_{rt} + \sum P_r d_r$	$d_{rt} = t_s - c_{rt} - t_t + Y$
		$d_{con} = d_r = t_t - Y + D - H_c/2$

2) Additional Cases

- **정모멘트**

Location	조건 / Y_{PNA} / M_P	Distance from Y_{PNA} to mems
(a)	In Top Rib	$d_c = Y + t_c/2$
조건	$P_t + P_{sb} + \sum P_r + P_w + P_{st} \geq P_c + P_s + P_{rb} + P_{rt}$	$d_t = D - Y + t_t/2$
Y_{PNA} =	$\dfrac{P_t + P_{sb} + \sum P_r + P_w + P_{st} - P_c - P_s - P_{rb} - P_{rt}}{2P_w / D + 2 P_{st} / H_{st}}$	$d_{sb} = D - Y - H_{sb}/2$
		$d_s = Y + t_h + t_s/2$
M_p =	$P_{st} / 2 / H_{st} [Y^2 + (H_{st} - Y)^2] + P_c d_c + P_{sb} d_{sb} + P_w /2 / D [Y^2 + (D-Y)^2]$	$d_{rt} = Y + t_s + t_h - c_{rt}$
	$+ P_t d_t + P_s d_s + P_{rb} d_{rb} + P_{rt} d_{rt} + \sum P_r d_r$	$d_{rb} = Y + t_h + t_s - c_{rb}$
		$d_r = D - Y - H_c/2$

- **부모멘트**

Location	조건 / YPNA / MP	Distance from Y_{PNA} to mems
(b)	In Bot Rib	$d_c = D - Y + t_c/2$
조건	$P_c + P_{sb} + (H_{sb}/H_c)P_{con} + (H_{sb}/D)P_w \geq (D - H_{sb})P_w/D + P_{st} + P_t + P_{rb} + P_{rt}$	$d_t = Y + t_t/2$
Y_{PNA} =	$\dfrac{P_c + P_w + DP_{con}/H_c + (2D/H_{sb} - 1) P_{sb} - P_t - P_{st} - P_{rb} - P_{rt}}{2P_{sb} / H_{sb} + P_{con}/H_c + 2 P_w / D}$	$d_{st} = Y - H_{st}/2$
		$d_{rb} = Y + t_h + t_s - c_{rb}$
M_p =	$P_{sb} / 2 / H_{sb} [(D-Y)^2 + (H_{sb} - D + Y)^2] + P_w /2 / D [Y^2 + (D-Y)^2] + P_c d_c + P_t d_t$	$d_{rt} = Y + t_h + t_s - c_{rt}$
	$+ P_{con} (D-Y)^2 / 2 / H_c + P_{st} d_{st} + P_{rb} d_{rb} + P_{rt} d_{rt} + \sum P_r d_r$	$d_r = D - Y - H_c/2$
(c)	In Bot Con'c	$d_c = D - Y + t_c/2$
조건	$P_c + P_{sb} + P_{con} + (H_c/D)P_w \geq (D - H_c)P_w/D + P_{st} + P_t + P_{rb} + P_{rt}$	$d_t = Y + t_t/2$
Y_{PNA} =	$\dfrac{P_c + P_w + P_{sb} + DP_{con}/H_c - P_t - P_{st} - P_{rb} - P_{rt}}{P_{con}/H_c + 2 P_w / D}$	$d_{st} = Y - H_{st}/2$
		$d_{sb} = D - Y - H_{sb}/2$
M_p =	$P_w /2 / D [Y^2 + (D-Y)^2] + P_{con} (D - Y)^2 / 2 / H_c + P_c d_c + P_t d_t$	$d_{rb} = Y + t_h + t_s - c_{rb}$
	$+ P_{st} d_{st} + P_{sb} d_{sb} + P_{rb} d_{rb} + P_{rt} d_{rt} + \sum P_r d_r$	$d_{rt} = Y + t_h + t_s - c_{rt}$
		$d_r = D - Y - H_c/2$
(d)	In Top Rib	$d_c = D - Y + t_c/2$
조건	$P_c + P_{sb} + \sum P_r + P_{con} + P_w + P_{st} \geq P_t + P_{rb} + P_{rt}$	$d_t = Y + t_t/2$
Y_{PNA} =	$\dfrac{P_c + P_{sb} + \sum P_r + P_{con} + P_{st} + P_w - P_t - P_{rb} - P_{rt}}{2P_{st}/H_{st} + 2 P_w / D}$	$d_{sb} = D - Y - H_{sb}/2$
		$d_{rb} = Y + t_h + t_s - c_{rb}$
M_p =	$P_w [Y^2 + (D-Y)^2] / 2 / D + P_{st} [Y^2 - (H_{st} - Y)^2] / 2 / H_{st} + P_c d_c + P_t d_t$	$d_{rt} = Y + t_h + t_s - c_{rt}$
	$+ P_{con} d_{con} + P_{sb} d_{sb} + P_{rb} d_{rb} + P_{rt} d_{rt} + \sum P_r d_r$	$d_{con} = D - Y - H_c/2$
		$d_r = D - Y - H_c/2$

7.2.2. M_y 항복모멘트 산정

강.설 B.2.2

- 다음 식에서 M_{AD}를 구한다

$$F_{yc} \;=\; M_{D1} / S_{steel} + M_{D2} / S_{bot\_con} + M_{D3} / S_{longterm} + M_{AD\_C} / S_{shortterm}$$

$$F_{yt} \;=\; M_{D1} / S_{steel} + M_{D2} / S_{bot\_con} + M_{D3} / S_{longterm} + M_{AD\_T} / S_{shortterm}$$

$$M_{AD} \;=\; \min(M_{AD\_C} ; M_{AD\_T})$$

여기서,

$$M_{D1} = 1.25(M_{DC1} + M_{DC2})$$

$$M_{D2} = 1.25M_{DC3}$$

$$M_{D3} = 1.25M_{DC4} + 1.50M_{DW}$$

- 다음을 M_y 계산한다

$$M_y = M_{D1} + M_{D2} + M_{D3} + M_{AD}$$

7.2.3. 연성 요구조건

강.설 4.3.3.1.7.3

- 공칭항복강도 690MPa 균질 합성단면 or 상부 및 하부플랜지의 공칭항복강도 690MPa

$$\mathbf{D_p \le 0.3D_t}$$

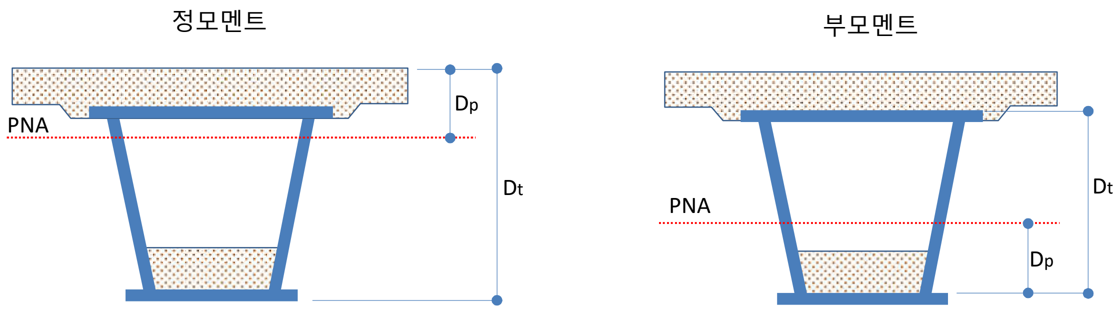
- 그 밖의 단면인 경우

$$\mathbf{D_p \le 0.42D_t}$$

여기서,

D_t = 합성단면의 전체 높이

D_p = 소성모멘트 상태어세 콘크리트 바닥판의 상단에서나 내부 con'c 하단에서 중립축까지의 거리



7.2.4. 콘크리트 응력 검토

- 콘크리트 종방향 응력을 : $0.6f'_c$ 이하

강.설 4.3.3.2.7.2

- 작용응력

$$f_{deck} = \frac{1.25DC4 + 1.5DW + 1.8LL}{n * S_{deck}}$$

$$f_{bot} = \frac{1.25DC3}{n * S_{bot1}} + \frac{4 + 1.5DW + 1.8LL}{n * S_{bot2}}$$

- 단기 탄성계수 n 사용

강.설 4.3.3.1.1.1

$$n = E / E_c$$

7.2.5. Flexure checking

Positive moment		Negative moment
Noncompact section	**Compact section**	
압축플랜지 (강.설 4.3-254) $f_{bu} \le \Phi_f F_{nc}$ 인장플랜지 (강.설 4.3-255 & 4.3-264) $f_{bu} \le \Phi_f F_{nt}$	(강.설 4.3-253) $M_u \le \Phi_f M_n$	(강.설 4.3-263) $f_{bu} \le \Phi_f F_{nc}$

1) 플랜지 응력 (f_{bu}) 산정

f_{bu} = 1.25(DC1 + DC2) / S_{steel} + 1.25DC3 / S_{bot_con} + (1.25DC4 + 1.5DW) / $S_{longterm}$ + 1.8LL / $S_{shortterm}$

2) F_{nc} 산정 (Nominal flexural resistance of compression flange)

In positive moment		In negative moment
(강.설 4.3.3.2.7.2(2))		(강.설 4.3.3.2.8.2(2))
$F_{nc} = R_b R_h F_{yc}$	for Open flange	$F_{nc} = F_{cb}\sqrt{[(1 - (f_v / \Phi_v / F_{cv})^2]}$
$F_{nc} = R_b R_h F_{yc}\Delta$	for Box flange	

f_v = $T / (2A_0\ t_f)$

Δ = $\sqrt{(1 - (f_v / F_{yc})^2)}$

T = 계수하중에 의한 내부토크

A_0 = 박스거더 단면의 폐합단면적

■ Calculation of R_h (Hybrid factor) **강.설 4.3.3.1.1.10(1)**

Case	R_h
$F_{yw} \ge F_{yf}$	1.0
Otherwise	$[12+\beta(3\rho-\rho^3)]/(12+2\beta)$

ρ = $\min(F_{yw}/f_n\ ;\ 1.0)$

f_n = $\max(F_{yf},\ f_{bu})$

β = $2D_n t_w/A_{fn}$

D_n = 단면의 탄성중립축으로 부터 양플린지 안쪽 면까지의 거리 중 큰값

A_{fn} = 플랜지 단면적과 D_n 방향에 위치한 플랜지 덮개판 면적의 합

■ Calculation of R_b (Web load shedding factor) **강.설 4.3.3.1.1.10(2)**

Case		R_b
$D/t_w \le 150$ (300)	In Positive moment	1.0
$b_f/(2t_f) \le 12$ $b_f \le D/6$ $t_f \ge 1.1t_w$	In Positive moment	1.0
$D/t_w \le 0.95\sqrt{(Ek/F_{yc})}$	수평보강재 있음	1.0
$2D_c/t_w \le \lambda_{rw}$		1.0
Otherwise		$1 - [a_{wc} / (1200 + 300a_{wc})]\ (2D_c / t_w - \lambda_{rw}) \le 1.0$

Since the cross - section proportion limits are satisfied, so R_b is taken as 1.0

■ Calculation of k - bend-buckling coefficient 강.설 4.3.3.1.1.9

Case	k
- 양쪽단이 압축 경우	7.2
- Otherwise	
보강재 없음	$9/(D_c/D)^2$
$d_s/D_c \geq 0.4$	$5.17/(d_s/D)^2 \geq 9/(D_c/D)^2$
$d_s/D_c < 0.4$	$11.64/[(D_c-d_s)/D]^2$

d_s = 수평보강재 중심선과 압축플랜지 안쪽면사이의 거리

강.설 4.3.3.1.1.10(2)

■ Calculation of a_{wc}

Case	a_{wc}
수평보강재 있음 정모멘트	$\dfrac{2D_c t_w}{b_{fc}t_{fc} + b_s t_s(1 - f_{DC1}/F_{yc})/(3n)}$
Otherwise	$2D_c t_w/(b_{fc}t_{fc})$

f_{DC1} = compression flange stress caused by factored permanent load applied before composite

■ Calculation of F_{cb} 강.설 4.3.3.2.8.2(2)

Case	F_{cb}
$\lambda_f \leq \lambda_p$	$R_b R_h F_{yc} \Delta$
$\lambda_p < \lambda_f \leq \lambda_r$	$R_b R_h F_{yc}[\Delta - (\Delta - (\Delta - 0.3)/R_h)\ (\lambda_f - \lambda_p)/(\lambda_r - \lambda_p)]$
$\lambda_r < \lambda_f$	$0.9ER_b k/\lambda_f^2$

λ_f = b_{fc} / t_{fc} if 종리브 없음

λ_f = w / t_{fc} if 종리브 있음

λ_r = $0.95 \sqrt{(Ek / (\Delta - 0.3) / F_{yc})}$

λ_p = $0.57 \sqrt{(Ek / \Delta / F_{yc})}$

Δ = $\sqrt{(1 - (f_v / F_{yc})^2)}$

f_v = $T / (2A_0\ t_f)$

T = 계수하중에 의한 내부토크

A_0 = 박스거더 단면의 폐합단면적

w = 압축플랜지의 종방향보강재 폭 또는 웨브로부터 가장 가까운 종방향보강재까지의 거리 중 큰 값

■ Calculation of F_{cv} (can be used the values from Constructibility) 강.설 4.3.3.2.8.2(2)

Case	F_{cv}
$\lambda_f \leq 1.12\sqrt{(Ek_s/F_{yc})}$	$0.58F_{yc}$
$1.12\sqrt{(Ek_s/F_{yc})} < \lambda_f \leq 1.40\sqrt{(Ek_s/F_{yc})}$	$0.65\sqrt{(F_{yc}Ek_s)}/\lambda_f$
$\lambda_f > 1.40\sqrt{(Ek_s/F_{yc})}$	$0.9Ek_s/\lambda_f^2$

■ Calculation of k, k_s - Plate-buckling coefficient (can be used the values from Constructibility)

Case		k	k_s
종리브 없음		4.0	5.34
종리브 있음	n = 1	$1.0 \leq [8I_s/(wt_{fc}^3)]^{1/3} \leq 4.0$	$\dfrac{5.34 + 2.84(I_s/w/t_{fc}^3)^{1/3}}{(n + 1)^2} \leq 5.34$
	n = 2	$1.0 \leq [0.894I_s/(wt_{fc}^3)]^{1/3} \leq 4.0$	

n = 등간격인 종방향보강재의 수
I_s = 종리브 단면2차모멘트
D_c = 탄성범위 내에서 웨브의 압축 측 높이
d_s = 수평보강재 중심선과 압축플랜지 안쪽면사이의 거리
w = 압축플랜지의 종방향보강재 사이 폭 또는 웨브로부터 가장 가까운종방향보강재까지의 거리 중 큰 값

3) 공칭휨강도 M_n 산정 (Nominal flexural resistance)

강.설 4.3.3.1.7.1 (2)

- 공칭항복강도 485MPa 이하인 강재로 균질 합성단면 or 상부 및 하부플랜지의 공칭항복강도 485MPa

Case	M_n
$D_p \le 0.1D_t$	$M_n = M_p$
Otherwise	$M_n = M_p(1.07 - 0.7D_p/D_t)$

- 공칭항복강도 690MPa 강재로 균질 합성단면 or 상부 및 하부플랜지의 공칭항복강도 690MPa

Case	M_n
$D_p \le 0.1D_t$	$M_n = M_p$
$0.1D_t < D_p \le 0.2D_t$	$M_n = M_p(1.19 - 1.9D_p/D_t)$
Otherwise	$M_n = M_p(1.0 - 0.95D_p/D_t)$

- 연속교의 경우 단며의 공칭휨강도는 다음 식을 만족해야한다

$M_n \le 1.3R_hM_y$

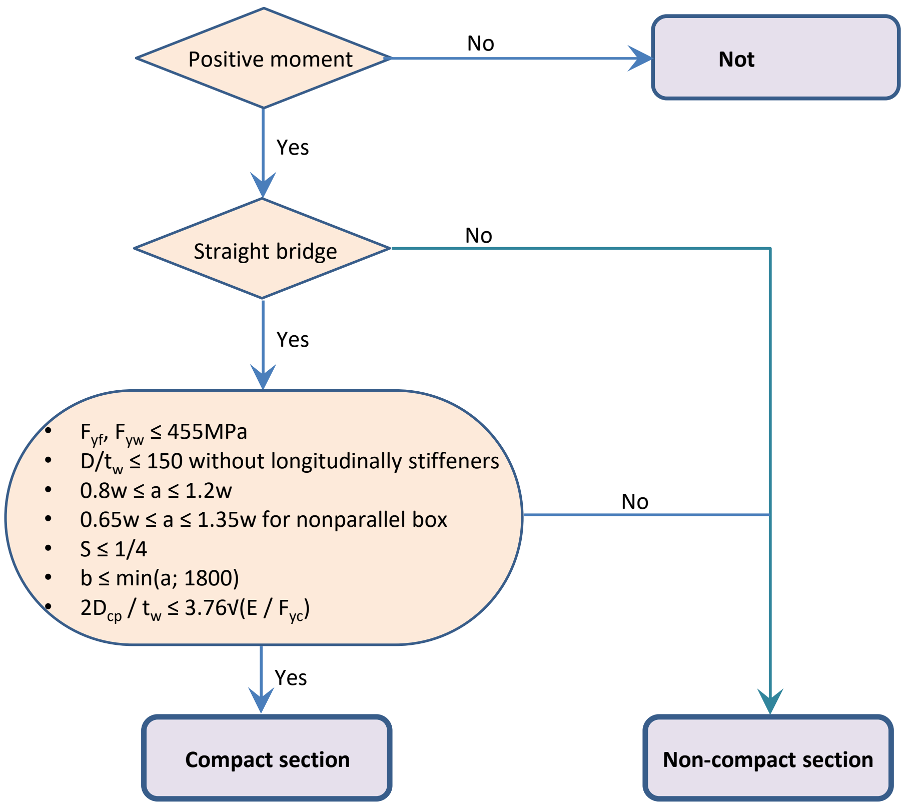
여기서,

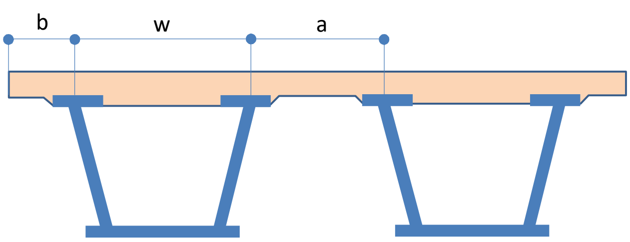
M_p = 소성모멘트
M_y = 항복모멘트
D_t = 합성단면의 전체높이
D_p = 소성모멘트 상태어세 콘크리트 바닥판의 상단에서나 내부 con'c 하단에서 중립축까지의 거리

4) F_{nt} 산정 (Nominal flexural resistance of tension flange)

Case		F_{nt}	
Positive moment		$R_h F_{yt} \Delta$	강.설 4.3.3.2.7.2 (2)
Negative moment	for Open flange	$R_h F_{yt}$	강.설 4.3.3.2.8.3
	for Box flange	$R_h F_{yt} \Delta$	

5) Classification of compact or noncompact section 강.설 4.3.3.2.6.2 (2)





a = 자간 중앙에서의 안접 박스 간 플랜지의 중심간격

w = 같이 각 박스단면의 플랜지 중심간격

b = 난간이나 연석을 포함한 바닥판의 내민부

S = 웨브의 경사도

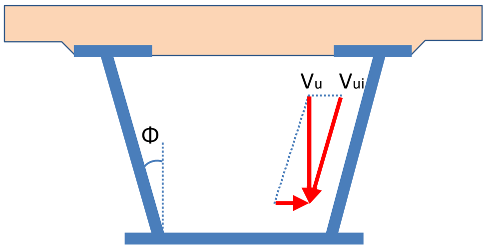
D_{cp} = 소성모멘트 적용 시 압축을 받는 웨브의 높이

D_{cp} > 0 for the case the plastic neutral axis is in the web, others cases D_{cp} = 0

7.2.3. Web checking

강.설 4.3.3.2.9

$$V_{ui} \leq \Phi_v V_n$$



V_{ui} = $V_u/\cos\Phi$

V_u = 경사진 웨브 1개에 작용하는 계수하중에 의한 전단력

Φ = 연직축에 대한 웨브의 경사각

■ Calculation of V_n (Nominal shear resistance)

Case	V_n	
Unstiffened web	$C \cdot V_p = C \cdot 0.58 F_{yw} D t_w$	강.설 4.3.3.1.9.2
Stiffened web		
- End panels	$C \cdot V_p = C \cdot 0.58 F_{yw} D t_w$	강.설 4.3.3.1.9.3(3)
- Interior panels		강.설 4.3.3.1.9.3(2)
$2Dt_w / (b_{fc}t_{fc} + b_{ft}t_{ft}) \leq 2.5$	$0.58F_{yw}Dt_w\,[C + 0.87(1 - C) / \sqrt{(1 + d_0^2/ D^2)}]$	
Otherwise	$0.58F_{yw}Dt_w\,[C + 0.87(1 - C) / \sqrt{(1 + d_0^2/ D^2 + d_0/D)}]$	

■ Ratio of shear buckling resistance (C) 산정

강.설 4.3.3.1.9.3(2)

Case	C	
$D/t_w \leq 1.12\sqrt{(Ek/F_{yw})}$	1.0	(1)
$1.12\sqrt{(Ek/F_{yw})} < D/t_w \leq 1.40\sqrt{(Ek/F_{yw})}$	$1.12/(D/t_w)\sqrt{(Ek/F_{yw})}$	(2)
$D/t_w > 1.40\sqrt{(Ek/F_{yw})}$	$1.57(Ek/F_{yw})/(D/t_w)^2$	(3)

■ Calculation of k - shear-buckling ccoefficient

Case	k
Unstiffened web	5.0
Stiffened web	$5+5/(d_0/D)^2$

■ Classification of stiffened web and unstiffened web

(☞ 강.설 4.3.3.1.9.1(3))

Case	Classification
수직보강재 간격 $d_0 \leq 3D$ and 수평보강재 없음	Stiffened web
수직보강재 간격 $d_0 \leq 1.5D$ and 수평보강재 있음	Stiffened web
Otherwise	unstiffened web