LIMIT ANALYSIS OF BEAM-COLUMN CONNECTIONS (IV)-2

(⊥ Type Connections of Wideflange Members Subjected to Strong-axis Bending)

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Members of A.I.J.

§ 5. Kinematical Analysis

The Kinematical analyses are classified into four cases shown in Fig. 4 and Fig. 5, but the case (b) does not exist for $\alpha \geq 2$.

[Case (a)] From the Kinematically admissible velocity field shown in Fig. 6, the powers of load and dissipation, denoted by W and D , respectively, can be obtained by

$$W = 2 M \dot{\theta} \quad \dots\dots\dots(5.1)$$

$$D = 2 \alpha \lambda \sigma_0 h_b^2 t \dot{\theta} \quad \dots\dots\dots(5.2)$$

Equating W and D , gives the yield moment M as

$$M = \alpha \lambda \sigma_0 h_b^2 t \quad \dots\dots\dots(5.3)$$

The above equation is valid for $\xi \geq 0$ in case (c), So that the condition $\lambda \leq \frac{4\beta}{\alpha}$ must be satisfied.

[Case (b)] From Fig. 7, W and D are given by

$$W = 2 M \dot{\theta} \quad \dots\dots\dots(5.4)$$

Fig. 4 Classification of Kinematical Analysis

Fig. 5 Classification of Kinematical Analysis

Fig. 6 Kinematically Admissible Velocity Field in Case (a)

$$D = \{ [(1-\eta_2)^2 + (\alpha-\xi)^2] \lambda + [4\alpha\beta(\alpha-\xi) + 4\beta(1-\eta_2)] \\ + (1-\eta_1)^2 \lambda + 4(1-\eta_1)\beta + \xi(\eta_1+\eta_2)\lambda \} \sigma_0 h_b^2 t \dot{\theta} \quad \dots\dots\dots(5.5)$$

Equating W and D and minimizing M , the minimum value of M is obtained

as

$$M = \frac{1}{2\lambda} \{ 8\beta^2(-\alpha^2 + 2\alpha - 2) - 4\beta\lambda(\alpha^2 - 4\alpha + 2) \\ - \lambda^2(\alpha^2 - 4\alpha + 2) \} \sigma_0 h_b^2 t \quad \dots\dots\dots(5.6)$$

when

Fig. 7 Kinematically Admissible Velocity Field in Case (b)

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Table 9 Case H

regions	$\frac{\sigma_x}{\sigma_0}$	$\frac{\sigma_y}{\sigma_0}$	$\frac{\tau}{\sigma_0}$	$\left \frac{\sigma_1}{\sigma_0} \right , \left \frac{\sigma_2}{\sigma_0} \right , \left \frac{\sigma_1 - \sigma_2}{\sigma_0} \right _{\max}$
(1)	1	0	0	1
(2)	0	0	0	0
(3)	$-\lambda k$	0	0	λk
(4)	0	1	0	1
(5)	0	$\frac{m^2}{\alpha^2} \cdot \frac{1}{k\lambda}$	0	$\frac{m^2}{\alpha^2} \cdot \frac{1}{k\lambda}$
(6)	$\frac{1}{\lambda}$	$\frac{1}{\lambda}$	$\left(\frac{2\beta+m}{\alpha} - \frac{m}{n} \right) \frac{1}{\lambda}$	$\left(1 + \frac{2\beta+m}{\alpha} - \frac{m}{n} \right) \frac{1}{\lambda}$
(7)	0	$\frac{m^2}{\alpha^2} \cdot \frac{1}{k\lambda}$	$\frac{2\beta+m}{\alpha} \cdot \frac{1}{\lambda}$	1
(8)	$-k$	0	$\frac{2\beta}{\alpha} \cdot \frac{1}{\lambda}$	1
η_1, η_2, ξ	$\eta_1=m, \quad \eta_2=l, \quad \xi=n$			
F in $\sigma_0 h_b t$	$F_b^{(A)} = F_b^{(D)} = F_b^{(B)} = 0$ $F_b^{(B)} = F_b^{(C)} = F_b^{(F)} = F_b^{(G)} = 2\beta$ $F_c^{(H)} = \frac{2\beta}{\alpha} \cdot l$ $F_c^{(I)} = \left[\frac{2\beta}{\alpha} \cdot l + \frac{1}{\alpha} (2-m-l)(2\beta+m) \right]$ $F_c^{(F)} = F_c^{(J)} = \left[\frac{2\beta}{\alpha} \cdot l + \frac{1}{\alpha} (2-m-l)(2\beta+m) + m \left(\frac{2\beta+m}{\alpha} - \frac{m}{n} \right) \right]$			

Table 10 Case I

regions	$\frac{\sigma_x}{\sigma_0}$	$\frac{\sigma_y}{\sigma_0}$	$\frac{\tau}{\sigma_0}$	$\left \frac{\sigma_1}{\sigma_0} \right , \left \frac{\sigma_2}{\sigma_0} \right , \left \frac{\sigma_1 - \sigma_2}{\sigma_0} \right _{\max}$
(1)	1	0	0	1
(2)	0	0	0	0
(3)	$-k\lambda$	0	0	$k\lambda$
(4)	0	$\frac{l \cdot m}{\alpha^2} + \frac{m}{\alpha} \cdot \frac{(2\beta+m)}{\alpha}$	0	$\frac{l \cdot m}{\alpha^2} + \frac{m}{\alpha} \cdot \frac{(2\beta+m)}{\alpha}$
(5)	0	$\frac{l \cdot m}{\alpha^2}$	0	$\frac{l \cdot m}{\alpha^2}$
(6)	$\frac{1}{\lambda}$	$\left[\frac{l \cdot m}{\alpha} + \frac{m}{\alpha} \cdot \frac{(2\beta+m)}{\alpha} \right] \frac{1}{\lambda}$	0	$\frac{1}{\lambda}$
(7)	0	$\frac{l \cdot m}{\alpha^2} \cdot \frac{1}{\lambda}$	$\frac{1}{\alpha} (2\beta+m) \frac{1}{\lambda}$	1
(8)	$-k$	0	$\frac{2\beta}{\alpha} \cdot \frac{1}{\lambda}$	1
η_1, η_2, ξ	$\eta_1=m, \quad \eta_2=l, \quad \xi = \frac{\alpha m}{2\beta+m}$			
F in $\sigma_0 h_b t$	$F_b^{(A)} = F_b^{(D)} = F_b^{(B)} = 0$ $F_b^{(B)} = F_b^{(C)} = F_b^{(E)} = F_b^{(F)} = F_b^{(G)} = 2\beta$ $F_c^{(H)} = \frac{2\beta}{\alpha} \cdot l$ $F_c^{(I)} = F_c^{(F)} = F_c^{(J)} = \left\{ \frac{2\beta}{\alpha} \cdot l + \frac{1}{\alpha} [2\beta+m] (2-m-l) \right\}$			

Table 11 Case J

regions	$\frac{\sigma_x}{\sigma_0}$	$\frac{\sigma_y}{\sigma_0}$	$\frac{\tau}{\sigma_0}$	$\left \frac{\sigma_1}{\sigma_0} \right , \left \frac{\sigma_2}{\sigma_0} \right , \left \frac{\sigma_1 - \sigma_2}{\sigma_0} \right _{\max}$
(1)	1	0	0	1
(2)	0	0	0	0
(3)	$-\lambda k$	0	0	λk
(4)	0	1	0	1
(5)	0	$\frac{l}{\alpha^2} \cdot m$	0	$\frac{l}{\alpha^2} \cdot m$
(6)	$\frac{1}{\lambda}$	$\frac{1}{\lambda}$	$\left(\frac{2\beta}{\alpha} + \frac{m}{\alpha} - \frac{q}{r} \right) \frac{1}{\lambda}$	$\left(1 + \frac{2\beta}{\alpha} + \frac{m}{\alpha} - \frac{q}{r} \right) \frac{1}{\lambda}$
(7)	0	$\frac{l \cdot m}{\alpha^2} \cdot \frac{1}{\lambda}$	$\left(\frac{2\beta}{\alpha} + \frac{m}{\alpha} \right) \frac{1}{\lambda}$	1
(8)	$-k$	0	$\frac{2\beta}{\alpha} \cdot \frac{1}{\lambda}$	1
η_1, η_2, ξ	$\eta_1 = q, \quad \eta_2 = l, \quad \xi = r$			
F in $\sigma_0 h_{bt}$	$F_b^{(A)} = F_b^{(D)} = F_c^{(B)} = 0, \quad F_b^{(E)} = F_b^{(C)} = 2\beta$ $F_b^{(E)} = \frac{1}{\alpha} (2\beta + m)(\alpha - r)$ $F_b^{(F)} = F_b^{(G)} = \frac{1}{\alpha} (2\beta + m)(\alpha - r) + \frac{2\beta}{\alpha} + \frac{1}{\alpha} \cdot m - q$ $F_c^{(H)} = \frac{2\beta}{\alpha} \cdot l$ $F_c^{(I)} = \left\{ \frac{2\beta}{\alpha} \cdot l + \frac{1}{\alpha} (2\beta + m)(2 - q - l) \right\}$ $F_c^{(F)} = F_c^{(J)} = 2\alpha\beta$			

Table 12 Case K

regions	$\frac{\sigma_x}{\sigma_0}$	$\frac{\sigma_y}{\sigma_0}$	$\frac{\tau}{\sigma_0}$	$\left \frac{\sigma_1}{\sigma_0} \right , \left \frac{\sigma_2}{\sigma_0} \right , \left \frac{\sigma_1 - \sigma_2}{\sigma_0} \right _{\max}$
(1)	$\frac{r}{s} \left(\frac{2\beta}{\alpha} + \frac{m}{\alpha} \right)$	0	0	$\frac{r}{s} \left(\frac{2\beta}{\alpha} + \frac{m}{\alpha} \right)$
(2)	0	0	0	0
(3)	$-\lambda k$	0	0	λk
(4)	0	1	0	1
(5)	0	$\frac{l}{\alpha^2} \cdot m$	0	$\frac{l}{\alpha^2} \cdot m$
(6)	$\frac{r}{s} \left(\frac{2\beta}{\alpha} + \frac{m}{\alpha} \right) \frac{1}{\lambda}$	$\frac{1}{\lambda}$	0	$\frac{1}{\lambda}$
(7)	0	$\frac{l \cdot m}{\alpha^2} \cdot \frac{1}{\lambda}$	$\left(\frac{2\beta}{\alpha} + \frac{1}{\alpha} m \right) \frac{1}{\lambda}$	1
(8)	$-k$	0	$\frac{2\beta}{\alpha\lambda}$	1
η_1, η_2, ξ	$\eta_1 = s, \quad \eta_2 = l, \quad \xi = r$			
F in $\sigma_0 h_{bt}$	$F_b^{(A)} = F_b^{(B)} = F_c^{(B)} = 0$ $F_b^{(B)} = F_c^{(C)} = 2\beta$ $F_b^{(E)} = F_b^{(F)} = F_b^{(G)} = \frac{1}{\alpha} (2\beta + m)(\alpha - r)$ $F_c^{(H)} = \frac{2\beta}{\alpha} \cdot m$ $F_c^{(I)} = F_c^{(F)} = F_c^{(J)} = 2\alpha\beta$			

Table 13 Case L

regions	$\frac{\sigma_x}{\sigma_0}$	$\frac{\sigma_y}{\sigma_0}$	$\frac{\tau}{\sigma_0}$	$\left \frac{\sigma_1}{\sigma_0} \right , \left \frac{\sigma_2}{\sigma_0} \right , \left \frac{\sigma_1 - \sigma_2}{\sigma_0} \right _{\max}$
(1)	$\frac{p}{s} \left(\frac{2\beta}{\alpha} + \frac{m}{\alpha} \right)$	0	0	$\frac{p}{s} \left(\frac{2\beta}{\alpha} + \frac{m}{\alpha} \right)$
(2)	0	0	0	0
(3)	$-\lambda k$	0	0	λk
(4)	0	$\frac{l}{\alpha^2} m + \frac{s}{p} \left(\frac{2\beta}{\alpha} + \frac{m}{\alpha} \right)$	0	$\frac{l}{\alpha^2} m + \frac{s}{p} \left(\frac{2\beta}{\alpha} + \frac{m}{\alpha} \right)$
(5)	0	$\frac{l}{\alpha^2} \cdot m$	0	$\frac{l}{\alpha^2} \cdot m$
(6)	$\frac{p}{s} \left(\frac{2\beta}{\alpha} + \frac{m}{\alpha} \right) \frac{1}{\lambda}$	$\left[\frac{l}{\alpha^2} m + \frac{s}{p} \left(\frac{2\beta}{\alpha} + \frac{m}{\alpha} \right) \right] \frac{1}{\lambda}$	0	$\frac{p}{s} \left(\frac{2\beta}{\alpha} + \frac{m}{\alpha} \right) \frac{1}{\lambda}$
(7)	0	$\frac{l}{\alpha^2} \cdot m \frac{1}{\lambda}$	$\left(\frac{2\beta}{\alpha} + \frac{m}{\alpha} \right) \frac{1}{\lambda}$	1
(8)	$-k$	0	$\frac{2\beta}{\alpha} \cdot \frac{1}{\lambda}$	1
η_1, η_2, ξ	$\eta_1 = s, \quad \eta_2 = l, \quad \xi = p$			
F in $\sigma_0 h b t$	$F_b^{(A)} = F_b^{(D)} = F_b^{(B)} = 0$ $F_b^{(B)} = F_b^{(C)} = F_b^{(E)} = F_b^{(F)} = F_b^{(G)} = 2\beta$ $F_c^{(H)} = \frac{2\beta}{\alpha} \cdot l$ $F_c^{(I)} = F_c^{(F)} = F_c^{(J)} = 2\alpha\beta$			

Table 14 Case M

regions	$\frac{\sigma_x}{\sigma_0}$	$\frac{\sigma_y}{\sigma_0}$	$\frac{\tau}{\sigma_0}$	$\left \frac{\sigma_1}{\sigma_0} \right , \left \frac{\sigma_2}{\sigma_0} \right , \left \frac{\sigma_1 - \sigma_2}{\sigma_0} \right _{\max}$
(1)	1	0	0	1
(2)	0	0	0	0
(3)	$-\lambda k$	0	0	λk
(4)	0	$\frac{\lambda k}{\alpha^2} + \frac{\lambda k}{u} \left(\frac{2\beta}{\alpha} + \frac{\lambda k}{\alpha} \right)$	0	$\frac{\lambda k}{\alpha^2} + \frac{\lambda k}{u} \left(\frac{2\beta}{\alpha} + \frac{\lambda k}{\alpha} \right)$
(5)	0	$\frac{1}{\alpha^2} \lambda k$	0	$\frac{1}{\alpha^2} \lambda k$
(6)	$\frac{1}{\lambda}$	$\left[\frac{\lambda k}{\alpha^2} + \frac{\lambda k}{u} \left(\frac{2\beta}{\alpha} + \frac{\lambda k}{\alpha} \right) \right] \frac{1}{\lambda}$	0	$\frac{1}{\lambda}$
(7)	0	$\frac{\lambda k}{\alpha^2} \cdot \frac{1}{\lambda}$	$\left(\frac{2\beta}{\alpha} + \frac{\lambda k}{\alpha} \right) \frac{1}{\lambda}$	$\frac{1}{\lambda} \sqrt{\left(\frac{\lambda k}{\alpha^2} \right)^2 + 4 \left(\frac{\lambda k}{\alpha} \right)^2}$
(8)	$-k$	0	$\frac{2\beta}{\alpha} \cdot \frac{1}{\lambda}$	1
η_1, η_2, ξ	$\eta_1 = \lambda k, \quad \eta_2 = 1, \quad \xi = u$			
F in $\sigma_0 h b t$	$F_b^{(A)} = F_b^{(D)} = F_c^{(B)} = 0$ $F_b^{(B)} = F_b^{(C)} = F_b^{(E)} = F_b^{(F)} = F_b^{(G)} = 2\beta$ $F_c^{(H)} = \frac{2\beta}{\alpha}$ $F_c^{(I)} = F_c^{(F)} = F_c^{(J)} = \left\{ \frac{2\beta}{\alpha} + \frac{1}{\alpha} (2\beta + \lambda k) (1 - \lambda k) \right\}$			

Table 15 Case N

regions	$\frac{\sigma_x}{\sigma_0}$	$\frac{\sigma_y}{\sigma_0}$	$\frac{\tau}{\sigma_0}$	$\left \frac{\sigma_1}{\sigma_0} \right , \left \frac{\sigma_2}{\sigma_0} \right , \left \frac{\sigma_1 - \sigma_2}{\sigma_0} \right _{\max}$
(1)	—	—	—	—
(2)	0	0	0	0
(3)	—	—	—	—
(4)	—	—	—	—
(5)	0	0	0	0
(6)	—	—	—	—
(7)	0	0	$\frac{1}{2}$	1
(8)	—	—	—	—
η_1, η_2, ξ	$\eta_1=0, \quad \eta_2=0, \quad \xi=0$			
F in $\sigma_0 h_b t$	$F_b^{(A)} = F_b^{(D)} = F_c^{(B)} = 0$ $F_b^{(B)} = F_b^{(C)} = F_b^{(F)} = F_b^{(G)} = \frac{\alpha\lambda}{2}$ $F_c^{(F)} = F_c^{(J)} = \lambda$			

Table 16 Necessary Conditions to Satisfy Yield Conditions

Case	Conditions for $\left \frac{\sigma_1}{\sigma_2} \right , \left \frac{\sigma_2}{\sigma_0} \right , \left \frac{\sigma_1 - \sigma_2}{\sigma_0} \right \leq 1$	Conditions for $F_b \leq 2\beta\sigma_0 h_b t, F_c \leq 2\alpha\beta\sigma_0 h_b t$
A	(2.5), (2.3)	(2.7) [from $\tau^{(6)} \geq 0$]
B	(2.5), (2.8)	—
C	(2.6), (2.3)	$F_b^{(E)} \leq F_b^{(F)}$ [from $\tau^{(6)} \geq 0$ (2.9)], $F_c^{(J)} \leq F_c^{(F)}$ [from $\tau^{(6)} \geq 0$ (2.9)] (2.6), (2.21), $F_c^{(F)} \leq 2\alpha\beta$
D	(2.3), (2.10), (2.6)	(2.13), (2.6), $F_c^{(J)} \leq 2\alpha\beta$
E	(2.3), (2.6)	$F_b^{(E)} \leq F_b^{(F)}$ [from $\tau^{(6)} \geq 0$ (2.23)], $F_c^{(J)} \leq F_c^{(F)}$ [from $\tau^{(6)} \geq 0$ (2.23)] (2.22), $F_b^{(F)} \leq 2\beta$
F	(2.3), (2.6), (2.24)	(2.7), $F_b^{(F)} \leq 2\beta$
G	(2.3), (2.6), (2.14), (2.28)	—
H	(2.1), (2.4)	$F_b^{(E)} \leq F_b^{(F)}$ [from $\tau^{(6)} \geq 0$ (2.11)], $F_c^{(J)} \leq F_c^{(F)}$ [from $\tau^{(6)} \geq 0$ (2.11)] (2.20), $F_c^{(F)} \leq 2\alpha\beta$
I	(2.1), (2.12), (2.4), (2.18)	(2.15), $F_c^{(J)} \leq 2\beta\alpha$
J	(2.1), (2.4)	$F_b^{(E)} \leq F_b^{(F)}$ [from $\tau^{(6)} \geq 0$ (2.25)], $F_c^{(J)} \leq F_c^{(F)}$ [from $\tau^{(6)} \geq 0$ (2.25)] (2.19), $F_b^{(F)} \leq 2\beta$
K	(2.1), (2.4), (2.26)	(2.29), $F_b^{(E)} \leq 2\beta$
L	(2.1), (2.4), (2.16), (3.30)	—
M	(2.3), (2.17)	—
N	—	(2.2)

$$\left. \begin{aligned} \eta_1 = \eta_2 = \frac{1}{\lambda} (\lambda + 2\beta)(2 - \alpha) \\ \xi = \frac{2}{\lambda} (\lambda + 2\beta)(\alpha - 1) \end{aligned} \right\} \dots\dots\dots (5.7)$$

The assumed velocity field is limited by the conditions of $0 \leq \xi \leq \alpha$, $0 \leq \eta_1 \leq 1$, $0 \leq \eta_2 \leq 1$, so that

$$2\beta(2 - \alpha) + \lambda \leq \alpha\lambda \leq 4\beta(1 - \alpha) + 2\lambda \dots\dots\dots (5.8)$$

must be satisfied, according to eq. (5.6).

[Case (c)] From Fig. 8, the power of load W and dissipation D are given by

$$W = 2M\dot{\theta} \dots\dots\dots (5.9)$$

$$D = [2\alpha\lambda(1 - \xi) + 8\beta\xi + 2\xi^2]\sigma_0 h_b^2 t \dot{\theta} \dots\dots\dots (5.10)$$

Equating W and D and minimizing M , we can obtain minimum value of M as

$$M = \left[\alpha\lambda - \left(\frac{\alpha\lambda}{2} - 2\beta \right)^2 \right] \sigma_0 h_b^2 t \dots\dots\dots (5.11)$$

when

$$\xi = \frac{1}{2} (\alpha\lambda - 4\beta) \dots\dots\dots (5.12)$$

The assumed velocity field is valid for $0 \leq \xi \leq 1$, so that the condition

$$\frac{4\beta}{\alpha} \leq \lambda \leq \frac{2 + 4\beta}{\alpha} \dots\dots\dots (5.13)$$

must be satisfied according to eq. (5.12).

[Case (d)] From the velocity field shown in Fig. 9, we can easily obtain

$$M = (1 + 4\beta)\sigma_0 h_b^2 t \dots\dots\dots (5.14)$$

by taking $\xi = 1$ in case (c).

§ 6. Conclusion

The numerical results of lower and upper bounds of yield moments are shown in Fig. 10 (a)~(f), where solid and dashed lines present lower and upper bounds, respectively, and M_0 denotes the fully plastic moment of beam given by

$$M_0 = (1 + 4\beta)\sigma_0 h_b^2 t \dots\dots\dots (6.1)$$

It is concluded from these figures that the connections without reinforcement of web cannot transmit enough the fully plastic moment of beam. In order to transmit the fully plastic moment perfectly, the

Fig. 8 Kinematically Admissible Velocity Field in Case (c)

Fig. 9 Kinematically Admissible Velocity Field in Case (d)

Fig. 10 (a) Reduction of Yield Moment

Fig. 10 (b) Reduction of Yield Moment

Fig. 10 (c) Reduction of Yield Moment

Fig. 10 (d) Reduction of Yield Moment

Fig. 10 (e) Reduction of Yield Moment

Fig. 10 (f) Reduction of Yield Moment

required thickness ratio of the connection-web is

$$\lambda \geq \frac{2+4\beta}{\alpha} \quad \dots\dots\dots (6.2)$$

for upper bound, and

$$\lambda \geq \sqrt{\frac{1}{\alpha^4} + 4\left(\frac{1}{b}\right)^2} \quad [\text{from eq. (2.5)}] \quad \dots\dots\dots (6.3)$$

for lower bound.

References

- (1) H. Tanaka, et al : Limit Analysis of Beam-Column Connections (I-1), (I-2), (II), (III), Trans. of A.I.J. No. 148, 149, June, July, 1968.

柱はり接合部の極限解析(IV-2)梗概

——強軸曲げをうける⊥字形接合部——

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§ 5. 運動的解析

運動的許容速度場による解析は図4と図5に示すような(a), (b), (c), (d)の場合に分けて行なう。(a)図6の速度場から荷重のなす仕事率 W とエネルギー散逸率 D は式(5.1)と(5.2)である。これらを等置すると M は式(5.3)より求められる。(b)図7の速度場において荷重のなす仕事率 W とエネルギー散逸率 D は式(5.4)と(5.5)しになる。これらの式を等置して M の最小値を求めると式(5.7)において式(5.6)となる。上式は ξ , η_1 と η_2 の幾何学的制限式(5.8)の範囲におい

て成立する。(c)図8に示す速度場から荷重のなす仕事率 W とエネルギー散逸率 D は式(5.9)と(5.10)である。これらの式を等置して、 M の最小値を求めると式(5.12)において式(5.11)になる。上式は ξ の幾何学的制限式(5.13)の範囲において成立する。(d)図9の速度場から W と D を求めて、それらの式を等置すると M は式(5.14)から求められる。

§ 6. 結 論

降伏モーメントの上, 下界 M とはりの全塑性モーメントとの比を図10(a)~(f)に示す。図中 M_0 は式(6.1)である。図から分るように, はりの全塑性モーメントを完全に伝えるための接合部ウェブ厚比は上界において, 式(6.2)下界は(6.3)である。

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SYNOPSIS

U.D.C. 691.32 : 620.192.5

STUDIES ON THE QUALITY OF MIXING WATER FOR CONCRETING

—1. Influence for setting properties, strength gain, drying shrinkage of mortar or concrete—

by Dr. TOYOKAZU SHIIRE, Assit. Prof. of Tokyo Institute of Tech., KAZUMI KODAMA, Nisso Master Builders Co., Ltd. Research Department. Members of A.I.J.

Tests were performed for influences of impurities contained in mixing water for concreting on setting properties, strength gain, drying shrinkage of mortar or concrete, etc.

The impurities tested consist of 35 kinds of substances relatively largely dissolved in river water and well water to be used as mixing water for concreting.

On the basis of the test results, consideration was made to set up a standard for examining mixing water for concreting. As a result, it is found that concentration of 10,000 ppm of impurities contained in water is criterion for determining whether or not the water in question can be used as mixing water for concreting.

U.D.C. 624.011.072.2 : 539.434

THE BENDING STRENGTH AND ALLOWABLE UNIT STRESS OF WOOD

(See page 21)

by Dr. HIDEO SUGIYAMA, Prof. Meiji Univ., Member of A.I.J.

U.D.C. 69.022 : 699.84 : 624.043

ELASTIC ANALYSIS OF SHEAR WALLS LOADED SYMMETRICALLY WITH REGARD TO THEIR LONGITUDINAL AND TRANSVERSAL CENTER LINES —Part 1. Airy's Stress Function, Stresses, Displacements, Etc.

(See page 31)

by Dr. MASAHEDE TOMII, Prof. of Kyushu Univ. and IKUO TOKUHIRO, Assistant of Kyushu Univ. Members of A.I.J.

U.D.C. 624.078 : 624.071.3/072.2.

LIMIT ANALYSIS OF BEAM-COLUMN CONNECTIONS (IV-2)

(⊥ Type Connections of Wideflange Members Subjected to Strong-Axis Bending (See page 41)

by Dr. HISASHII TANAKA, Prof. Inst. of Indu. Sci., Univ. of Tokyo, YUNG CHUAN LINE, Graduate Student, Univ. of Tokyo, Members of A.I.J.