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ภาคผนวก ก

สมการแรงดัดของรูปแบบยิลด์ไลน์ต่าง ๆ

พ.1 แผ่นพื้นชนิดที่ 1

รูปที่ พ-1 (1) แสดงรูปทรงทางเรขาคณิตของแผ่นพื้นชนิดที่ 1 โอกาสที่จะเกิดรูปแบบยิลด์ไลน์มีอยู่ 2 รูปแบบด้วยกัน

พิจารณารูปที่ พ-1 (2) ใช้วิธีสมมูลย์ แรงที่ขั้วที่จุด E และ F มีค่าเป็นศูนย์
พิจารณาการสมมูลย์ของชิ้นส่วนที่ถูกแบ่งโดยยิลด์ไลน์ โดยการคิดผลรวมของแรงตัดรอบที่รองรับ

ชิ้นส่วน ABE

$$(1+i_1)m_x S = W_u S L_2^2 \quad (\text{พ.1})$$

ชิ้นส่วน DAEF

$$(1+i_2)m_y L = \frac{W_u L_2 L_1^2}{6} + \frac{W_u L_3 L_1^2}{6} + \frac{W_u (L-L_2-L_3) L_1^2}{2} \quad (\text{พ.2})$$

ชิ้นส่วน BCFE

$$(1+i_4)m_y L = \frac{W_u L_2 (S-L_1)^2}{6} + \frac{W_u L_3 (S-L_1)^2}{6} + \frac{W_u (L-L_2-L_3) (S-L_1)^2}{2} \quad (\text{พ.3})$$

ชิ้นส่วน CDF

$$(1+i_3)m_x S = \frac{W_u S L_3^2}{6} \quad (\text{พ.4})$$

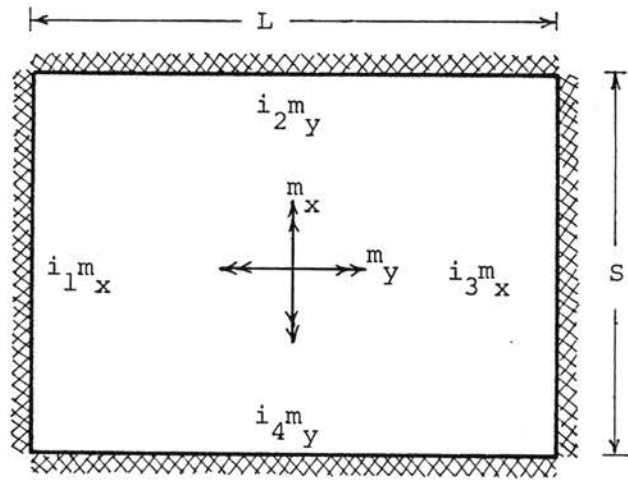
ทำการแก้สมการทั้งสี่ตามเอกสารอ้างอิง⁽¹⁶⁾ หากค่า L_1 , L_2 และ L_3 ได้สมการสำเร็จรูป แสดงความสัมพันธ์ระหว่างแรงดัดประลัยและน้ำหนักประลัยตั้งสมการ (พ.5)

$$m_y = \frac{W_u S^2 (S/L)^2 \left[\left\{ (X/Y)^2 + 3\mu (L/S)^2 \right\}^{\frac{1}{2}} - (X/Y) \right]^2}{6\mu Y^2} \quad (\text{พ.5})$$

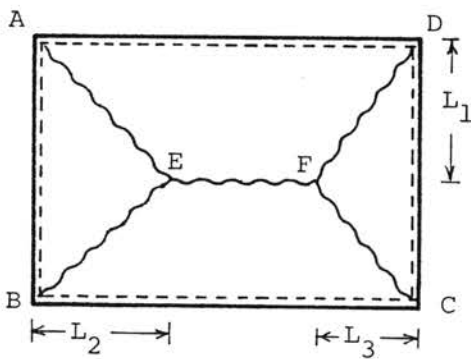
$$\text{เมื่อ } \mu = m_y/m_x$$

$$X = \sqrt{1+i_1} + \sqrt{1+i_3}$$

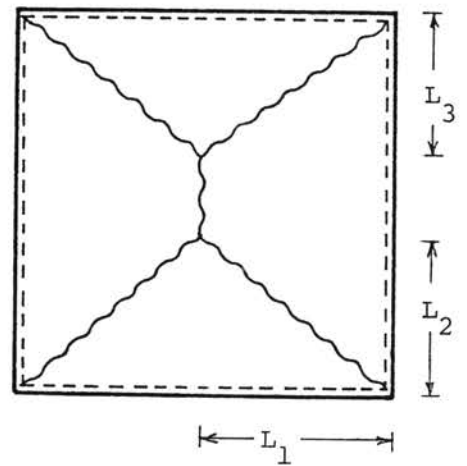
$$Y = \sqrt{1+i_2} + \sqrt{1+i_4}$$



(1)



(2)



(3)

รูปที่ พ-1 การวิบัติของแผ่นพื้นชนิดที่ 1

ในทำนองเดียวกัน พิจารณารูปแบบอีลด์ไลน์ที่ พ-1(3) ได้สมการสำเร็จรูปดังสมการ (พ.6)

$$m_y = \frac{w_u L^2 (L/S)^2 \left[\left\{ (Y/X)^2 + 3\mu (S/L)^2 \right\}^{1/2} - (Y/X) \right]^2}{6\mu^2 X^2} \quad (\text{พ.6})$$

พ.2 แผ่นพื้นชนิดที่ 2

รูปที่ พ-2(1) แสดงรูปทรงทางเรขาคณิตของแผ่นพื้นชนิดที่ 2 มีขอบอิสระหนึ่งด้าน โอกาสที่จะเกิดรูปแบบยิลด์ไลน์มีอยู่ 2 รูปแบบด้วยกัน

รูปที่ พ-2(2) สมมุติให้ระยะทรุดตัวที่จุด A เท่ากับหนึ่งหน่วย ได้สมการของพลังงานภายนอกเนื่องจากน้ำหนักแผ่นกระจายสม่ำเสมอ, น้ำหนักแนวเส้นและพลังงานภายในเนื่องจากแรงคัตบมยิลด์ไลน์ที่หมุนไป ดังแสดงในสมการ (พ.7), (พ.8) และ (พ.9) ตามลำดับ

$$W_{eu} = \frac{W_u LS}{6}(3-\beta_1-\beta_2) \quad (\text{พ.7})$$

$$W_{el} = \frac{PL}{2}(2-\beta_1-\beta_2) \quad (\text{พ.8})$$

$$W_i = m_y \left[\frac{(1+i_1)S}{\mu\beta_1 L} + \frac{(1+i_3)S}{\mu\beta_2 L} + \frac{L(i_2+\beta_1+\beta_2)}{S} \right] \quad (\text{พ.9})$$

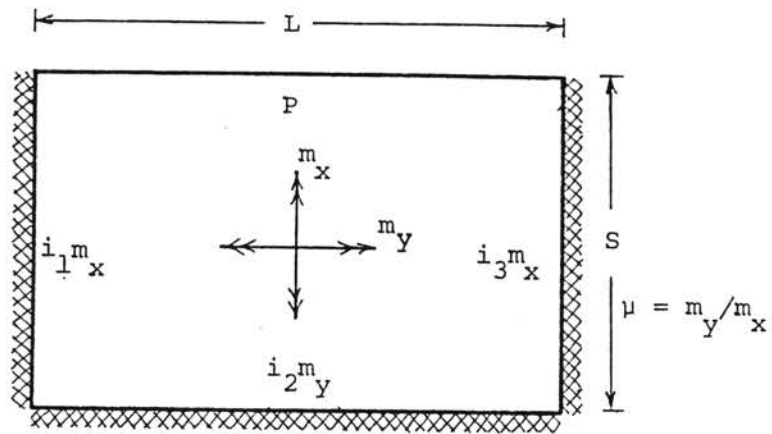
จากทฤษฎีพลังงานภายใน เท่ากับพลังงานภายนอกดังนั้น $W_i = W_{eu} + W_{el}$ จะได้ความสัมพันธ์ดังสมการ (พ.10)

$$m_y = \frac{W_u LS(3-\beta_1-\beta_2)}{6A} + \frac{PL(2-\beta_1-\beta_2)}{2A} \quad (\text{พ.10})$$

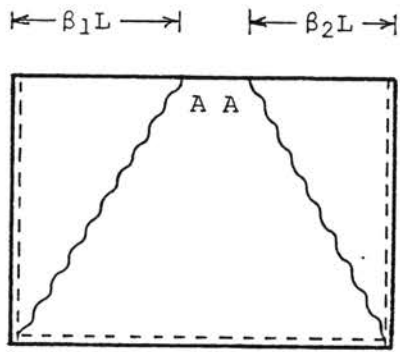
$$\text{เมื่อ } A = \frac{(1+i_1)S}{\mu\beta_1 L} + \frac{(1+i_3)S}{\mu\beta_2 L} + \frac{L(i_2+\beta_1+\beta_2)}{S}$$

รูปที่ พ-2(3) สมมุติให้ระยะทรุดตัวที่จุด A เท่ากับหนึ่งหน่วย ได้สมการความสัมพันธ์ดังสมการ (พ.11)

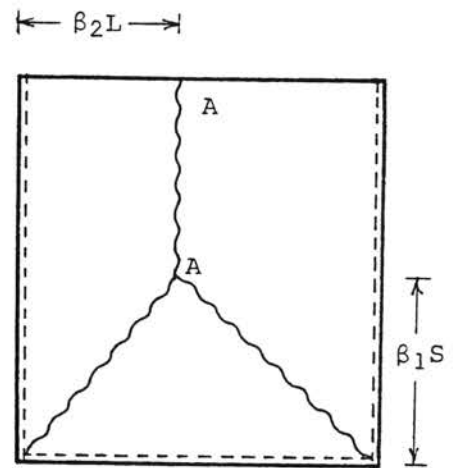
$$m_y = \frac{W_u LS(3-\beta_1)}{6A} + \frac{PL}{2A} \quad (\text{พ.11})$$



(1)



(2)



(3)

รูปที่ พ-2 การวิบัติของแผ่นพื้นชนิดที่ 2

$$\text{เมื่อ } A = \frac{(1+i_1)S}{\mu\beta_2L} + \frac{(1+i_3)S}{\mu L(1-\beta_2)} + \frac{(1+i_2)L}{\beta_1S}$$

พ.3 แผ่นพื้นชนิดที่ 3

รูปที่ พ-3(1) แสดงรูปทรงทางเรขาคณิตของแผ่นพื้นชนิดที่ 3 มีขอบอิสระสองด้าน โอกาสที่จะเกิดรูปแบบยิลด์ไลน์มีอยู่ 3 รูปแบบด้วยกัน

รูปที่ พ-3(2) สมมติให้ระยะทรุดตัวที่จุด A เท่ากับหนึ่งหน่วย ได้สมการของพลังงานดังแสดงในสมการ (พ.12), (พ.13) และ (พ.14)

$$W_{eu} = \frac{W_u LS}{6} (3-\beta) \quad (\text{พ.12})$$

$$W_e = \frac{1}{2}[P_1 L(2-\beta) + P_2 S] \quad (\text{พ.13})$$

$$W_i = m_y \left[\frac{S}{\mu\beta L} + \frac{L}{S} \right] \quad (\text{พ.14})$$

จาก $W_i = W_{eu} + W_{el}$ ได้ความสัมพันธ์ดังสมการ (พ.15)

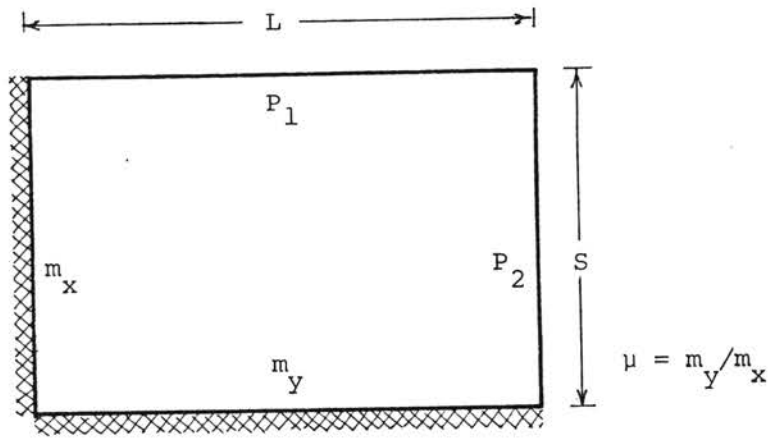
$$m_y = \frac{W_u LS(3-\beta)}{6A} + \frac{P_1 L(2-\beta) + P_2 S}{2A} \quad (\text{พ.15})$$

$$\text{เมื่อ } A = \frac{S}{\mu\beta L} + \frac{L}{S}$$

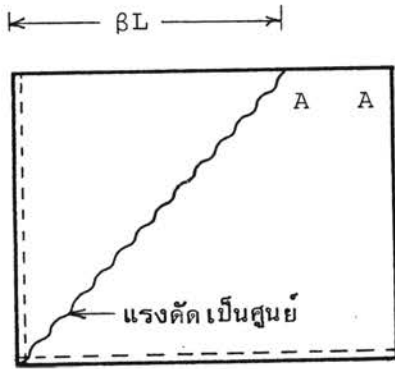
รูปที่ พ-3(3) สมมติให้ระยะทรุดตัวที่จุด A เท่ากับหนึ่งหน่วย ได้ความสัมพันธ์ดังสมการ (พ.16)

$$m_y = \frac{W_u LS(3-\beta)}{6A} + \frac{P_1 L + P_2 S(2-\beta)}{2A} \quad (\text{พ.16})$$

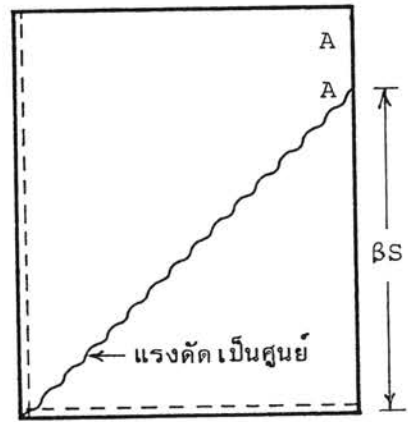
$$\text{เมื่อ } A = \frac{S}{\mu L} + \frac{L}{\beta S}$$



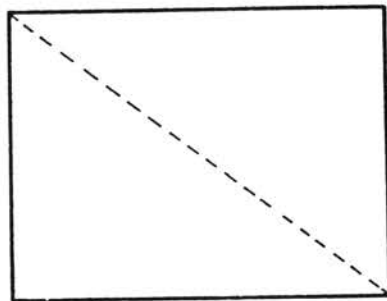
(1)



(2)



(3)



(4)

รูปที่ พ-3 การบิดของแผ่นพืชนิตที่ 3

รูปที่ พ-3 (4) ได้ความสัมพันธ์ดังสมการสำเร็จรูป (พ.17)

$$m_Y = \frac{W_u \mu L^2 S^2}{6(\mu L^2 + S^2)} + \frac{\mu L S (P_1 L + P_2 S)}{2(\mu L^2 + S^2)} \quad (\text{พ.17})$$

พ. 4 แผ่นพื้นชนิดที่ 4

รูปที่ พ-4(1) แสดงช่องเปิดขนาดใด ๆ อยู่ที่ยุ้มของแผ่นพื้นชนิดที่ 4 โอกาสที่จะเกิดรูปแบบยิลด์ไลน์มีอยู่ 8 รูปแบบด้วยกัน

รูปที่ พ-4(2) สมมุติให้ระยะทรุดตัวที่จุด A เท่ากับหนึ่งหน่วย ทำให้จุด B ทรุดตัว $\frac{(S-H)}{\beta_3 S}$ หน่วย ได้สมการของพลังงานดังสมการ (พ.18), (พ.19) และ (พ.20)

$$W_{eu} = \frac{W_u}{6\beta_3 S} [(S-H)^2 (3K-\beta_1 L) + \beta_3 S^2 (3L-3K-\beta_2 L)] \quad (\text{พ.18})$$

$$W_{el} = \frac{1}{2\beta_3 S} [P_1 (S-H) (2K-\beta_1 L) + P_2 \{\beta_2 S^2 (1-\beta_3) + \beta_3^2 S^2 - (S-H)^2\}] \quad (\text{พ.19})$$

$$W_i = \frac{m_y}{\beta_3 S} \left[\frac{(1+i_1)(S-H)^2}{\mu\beta_1 L} + L(\beta_1+i_4) + \frac{(L-K)(1+\beta_3 i_2)}{(1-\beta_3)} + \frac{(1+i_3)\beta_3 S^2}{\mu\beta_2 L} \right] \quad (\text{พ.20})$$

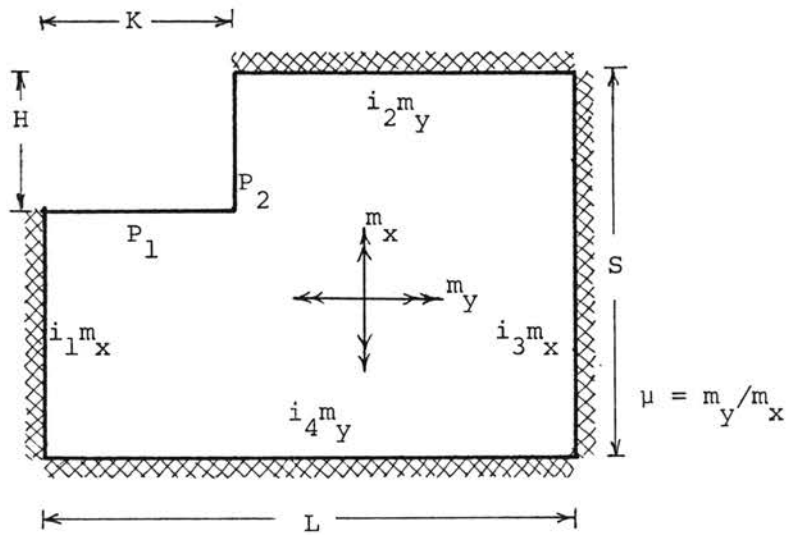
จาก $W_i = W_{eu} + W_{el}$ ได้ความสัมพันธ์ของแรงคัตกับน้ำหนักดังสมการ (พ.21)

$$m_y = \frac{W_u}{6A} [(S-H)^2 (3K-\beta_1 L) + \beta_3 S^2 (3L-3K-\beta_2 L)] + \frac{1}{2A} [P_1 (S-H) (2K-\beta_1 L) + P_2 \{\beta_3 S^2 (1-\beta_3) + \beta_3^2 S^2 - (S-H)^2\}] \quad (\text{พ.21})$$

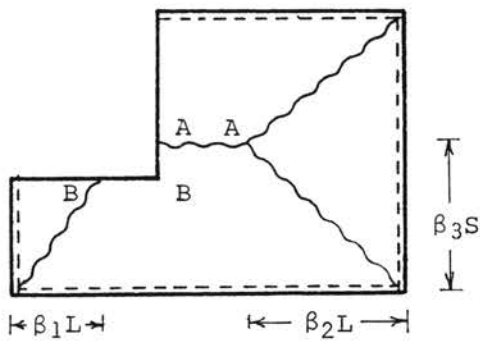
$$\text{เมื่อ } A = \frac{(1+i_1)(S-H)^2}{\mu\beta_1 L} + L(\beta_1+i_4) + \frac{(L-K)(1+\beta_3 i_2)}{(1-\beta_3)} + \frac{(1+i_3)\beta_3 S^2}{\mu\beta_2 L}$$

รูปที่ พ-4(3) สมมุติให้จุด A ทรุดตัวหนึ่งหน่วย ทำให้จุด B ทรุดตัว $\frac{(L-K)}{\beta_3 L}$ หน่วย ได้ความสัมพันธ์ของแรงคัตและน้ำหนักดังสมการ (พ.22)

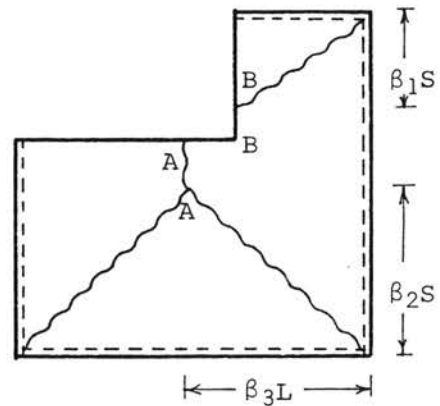
$$m_y = \frac{W_u \mu}{6A} [(L-K)^2 (3H-\beta_1 S) + \beta_3 L^2 (3S-3H-\beta_2 S)] + \frac{\mu}{2A} [P_1 \{\beta_3 L^2 (1-\beta_3) + \beta_3^2 L^2 - (L-K)^2\} + P_2 (L-K) (2H-\beta_1 S)] \quad (\text{พ.22})$$



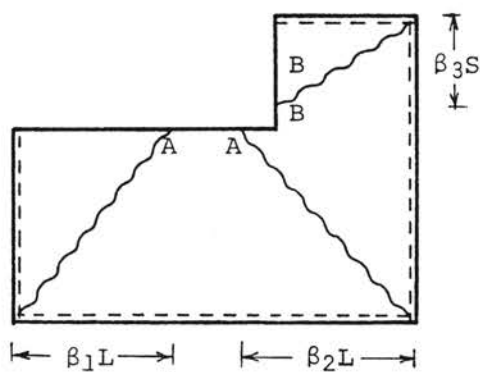
(1)



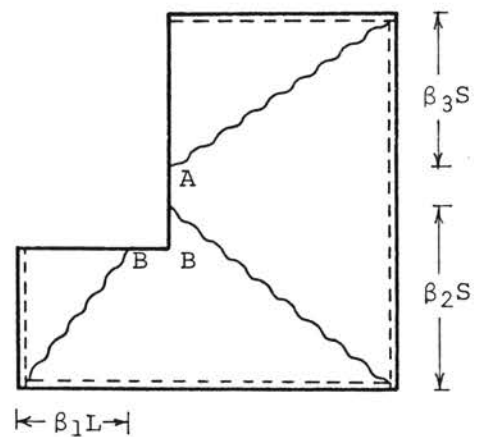
(2)



(3)

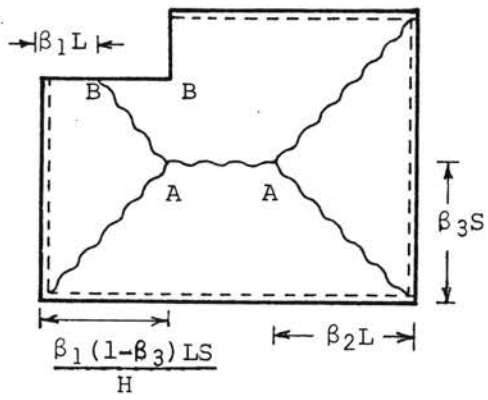


(4)

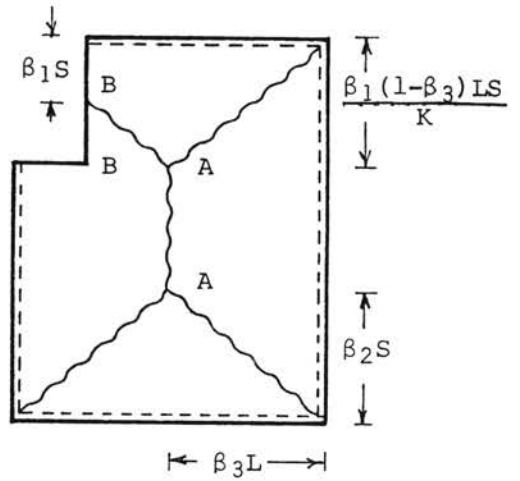


(5)

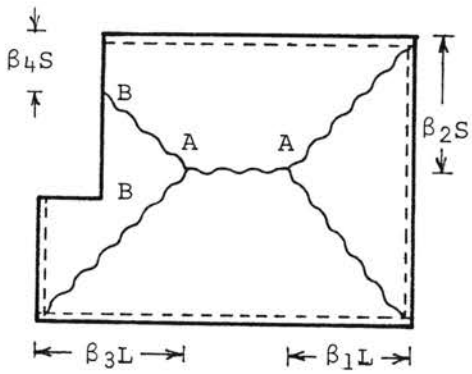
รูปที่ พ-4 การวิบัติของแผ่นพื้นชนิดที่ 4



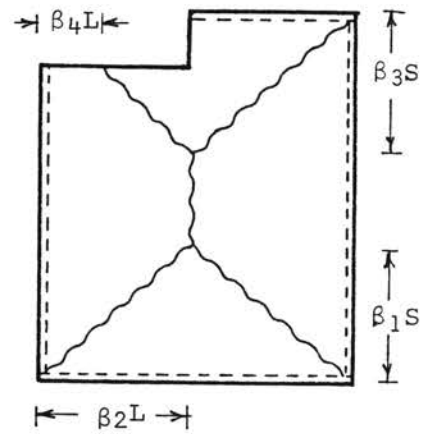
(6)



(7)



(8)



(9)

รูปที่ พ-4 (ต่อ) การวิบัติของแผ่นพื้นชนิดที่ 4

$$\text{เมื่อ } A = \frac{\mu(1+i_2)(L-K)^2}{\beta_1 S} + \frac{(S-H)(1+\beta_3 i_1)}{(1-\beta_3)} + S(\beta_1+i_3) + \frac{(1+i_4)\mu\beta_3 L^2}{\beta_2 S}$$

รูปที่ พ-4(4) สมมุติให้จุด A ทรวดตัวหนึ่งหน่วย ทำให้จุด B ทรวดตัว $\frac{(L-K)}{\beta_2 L}$ หน่วย ได้ความสัมพันธ์ของแรงดัดและน้ำหนักดั่งสมการ (พ.23)

$$m_y = \frac{W_u}{6A} [\beta_2 L^2 (S-H)(3-\beta_1-\beta_2) + (L-K)^2 (3H-\beta_3 S)] \\ + \frac{1}{2A} [P_1 \{2\beta_2 LK - \beta_1 \beta_2 L^2 - (\beta_2 L - L + K)^2\} + P_2 (L-K)(2H-\beta_3 S)] \quad (\text{พ.23})$$

$$\text{เมื่อ } A = \frac{(S-H)(\beta_1+\beta_2+\beta_2 i_1)}{\mu\beta_1} + \frac{\beta_2 L^2 (\beta_1+\beta_2+i_4)}{S-H} \\ + \frac{S(\beta_3+i_3)}{\mu} + \frac{(1+i_2)(L-K)^2}{\beta_3 S}$$

รูปที่ พ-4(5) สมมุติให้จุด A ทรวดตัวหนึ่งหน่วย ทำให้จุด B ทรวดตัว $\frac{(S-H)}{\beta_2 S}$ หน่วย ได้ความสัมพันธ์ของแรงดัดและน้ำหนักดั่งสมการ (พ.24)

$$m_y = \frac{W_u}{6A} [(S-H)^2 (3K-\beta_1 L) + \beta_2 S^2 (L-K)(3-\beta_2-\beta_3)] \\ + \frac{1}{2A} [P_1 (S-H)(2K-\beta_1 L) + P_2 \{2\beta_2 SH - \beta_2 \beta_3 S^2 - (\beta_2 S - S + H)^2\}] \quad (\text{พ.24})$$

$$\text{เมื่อ } A = \frac{(1+i_1)(S-H)^2}{\mu\beta_1 L} + \frac{\beta_2(1+i_2)(L-K)}{\beta_3} + \frac{\beta_2 S^2 (\beta_2+\beta_3+i_3)}{\mu(L-K)} \\ + L(\beta_1+1+i_4) - K$$

รูปที่ พ-4(6) สมมุติให้จุด A ทรวดตัวหนึ่งหน่วย ทำให้จุด B ทรวดตัว $\frac{H}{S(1-\beta_3)}$ หน่วย ได้ความสัมพันธ์ของแรงดัดและน้ำหนักดั่งสมการ (พ.25)

$$\begin{aligned}
 m_y &= \frac{W S(1-\beta_3)}{6A} [3\beta_1 LH - \beta_2 LS + 3LS(1-\beta_1\beta_3-\beta_1) \\
 &\quad - \beta_1 L \frac{(S-H-\beta_3 S)^3 + 3KH^3}{HS(1-\beta_3)} - \frac{(1-\beta_3)\beta_1\beta_3 LS^2}{H}] \\
 &\quad + \frac{1}{2A} [P_1 H(2K-\beta_1 L) + P_2 H^2] \quad (\text{พ. 25})
 \end{aligned}$$

$$\begin{aligned}
 \text{เมื่อ } A &= \frac{(1-i_1)(S-H)H}{\mu\beta_1 L} + \frac{(1+i_3)(1-\beta_3)S^2}{\mu\beta_2 L} \\
 &\quad + \frac{(1+i_4)(1-\beta_3)L}{\beta_3} + L(1+i_2-\beta_1) - Ki_2
 \end{aligned}$$

รูปที่ พ-4(7) สมมุติให้จุด A ทรวดตัวหนึ่งหน่วย ทำให้จุด B ทรวดตัว $\frac{K}{L(1-\beta_3)}$ หน่วย ได้ความสัมพันธ์ของแรงคัตและน้ำหนักดั่งสมการ (พ. 26)

$$\begin{aligned}
 m_y &= \frac{W \mu L(1-\beta_3)}{6A} [3\beta_1 SK - \beta_2 LS + 3LS(1+\beta_1\beta_2-\beta_1) \\
 &\quad - \frac{\beta_1 S(L-K-\beta_3 L)^3 + 3HK^3}{KL(1-\beta_3)} - \frac{(1-\beta_3)\beta_1\beta_3 SL^2}{K}] \\
 &\quad + \frac{\mu}{2A} [P_1 K^2 + P_2 K(2H-\beta_1 S)] \quad (\text{พ. 26})
 \end{aligned}$$

$$\begin{aligned}
 \text{เมื่อ } A &= \frac{(1+i_2)(L-K)K\mu}{\beta_1 S} + \frac{(1+i_3)(1-\beta_3)S}{\beta_3} \\
 &\quad + \frac{(1+i_4)(1-\beta_3)\mu L^2}{\beta_2 S} + S(1-\beta_1+i_1) - i_1 H
 \end{aligned}$$

รูปที่ พ-4(8) สมมุติให้จุด A ทรวดตัวหนึ่งหน่วย ทำให้จุด B ทรวดตัว $\frac{K}{\beta_3 L} = \frac{\beta_4}{\beta_2}$ หน่วย ได้ความสัมพันธ์ของแรงคัตและน้ำหนักดั่งสมการ (พ. 27)

$$m_y = \frac{W_u}{6A} \left[LS(3-\beta_1-\beta_3) + \frac{\beta_4 K}{\beta_2} (\beta_4 S - 3H) \right] + \frac{\beta_4}{2\beta_2 A} [P_1 K + 2P_2 H - P_2 \beta_4 S] \quad (\text{พ.27})$$

$$\text{เมื่อ } \beta_4 = \frac{\beta_2 K}{\beta_3 L}$$

$$A = \frac{(1+i_2)(L-K)}{\beta_2 S} + \frac{(1+i_3)S}{\beta_1 \mu L} + \frac{(1+i_4)L}{S(1-\beta_2)} + \frac{i_1(S-H)}{\beta_3 \mu L} + \frac{S(1-\beta_4)}{\beta_3 \mu L}$$

รูปที่ พ-4(๑) สมมุติให้จุด A ทอดตัวหนึ่งหน่วย ทำให้จุด B ทอดตัว $\frac{H}{\beta_3 S} = \frac{\beta_4}{\beta_2}$

หน่วย ได้ความสัมพันธ์ของแรงดัดและน้ำหนักดั่งสมการ (พ.28)

$$m_y = \frac{W_u}{6A} \left[LS(3-\beta_1-\beta_3) + \frac{\beta_4 H}{\beta_2} (\beta_4 L - 3K) \right] + \frac{\beta_4}{2\beta_2 A} [P_2 H + 2P_1 K - P_1 \beta_4 L] \quad (\text{พ.28})$$

$$\text{เมื่อ } \beta_4 = \frac{\beta_2 H}{\beta_3 S}$$

$$A = \frac{(1+i_1)(S-H)}{\beta_2 \mu L} + \frac{(1+i_4)L}{\beta_1 S} + \frac{(1+i_3)S}{\mu L(1-\beta_2)} + \frac{i_2(L-K)}{\beta_3 S} + \frac{L(1-\beta_4)}{\beta_3 S}$$

พ.5 แผ่นพื้นชนิดที่ 5

รูปที่ พ-5(1) แสดงตำแหน่งช่องเปิดขนาดใด ๆ อยู่บนด้านของแผ่นพื้นโดยที่ระยะ X น้อยกว่าหรือเท่ากับระยะ L-X-K โอกาสที่จะเกิดรูปแบบยิลด์ไลน์มีอยู่ 11 รูปแบบด้วยกัน

รูปที่ พ-5(2) สมมุติให้จุด A ทรวดตัวหนึ่งหน่วย ทำให้จุด B ทรวดตัว $\frac{H}{\beta_1 S}$ หน่วย ได้สมการพลังงานดังสมการ (พ.29), (พ.30) และ (พ.31)

$$W_{eu} = \frac{W_u}{6} \left[LS(3-\beta_2-\beta_3) - \frac{3KH^2}{\beta_1 S} \right] \quad (\text{พ.29})$$

$$W_{el} = \frac{H}{\beta_1 S} \left[\frac{H(P_1+P_3)}{2} + KP_2 \right] \quad (\text{พ.30})$$

$$W_i = m_y \left[\frac{S}{\mu L} \left(\frac{1+i_1}{\beta_2} + \frac{1+i_3}{\beta_3} \right) + \frac{(1+i_2)L}{S(1-\beta_1)} + \frac{L+i_4(L-K)}{\beta_1 S} \right] \quad (\text{พ.31})$$

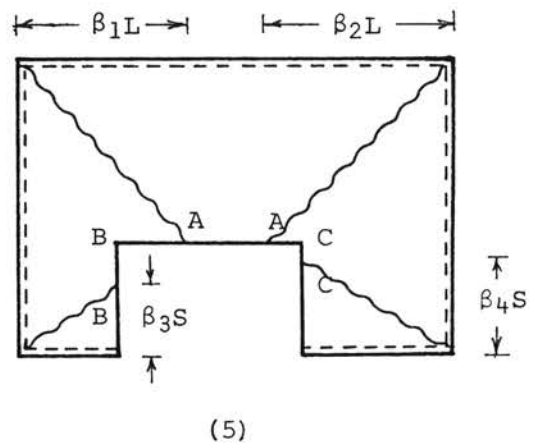
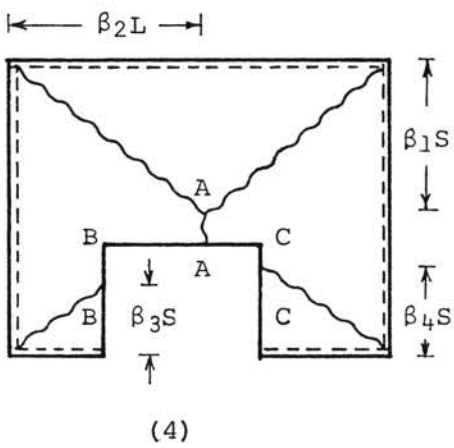
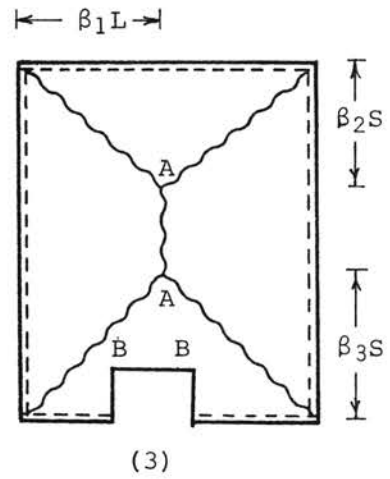
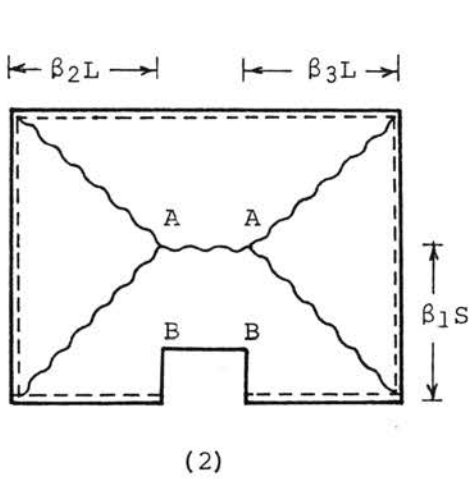
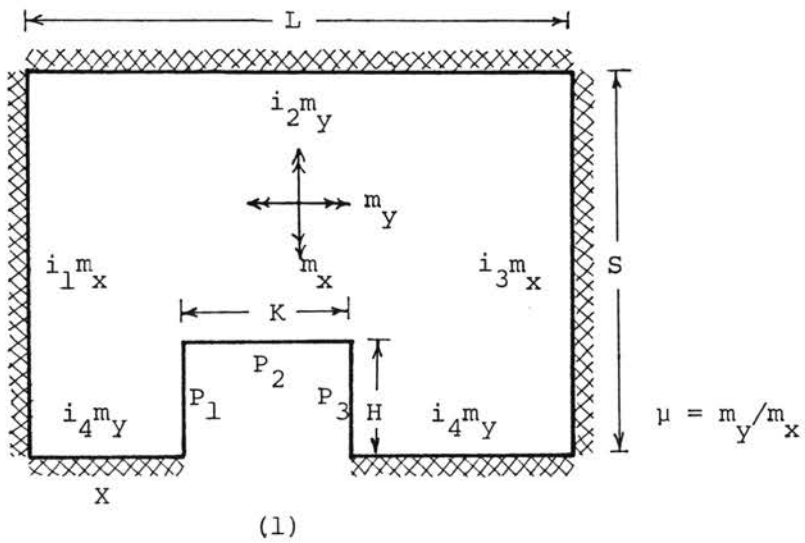
จาก $W_i = W_{eu} + W_{el}$ ได้ความสัมพันธ์ของแรงคัตกับน้ำหนักดังสมการ (พ.32)

$$m_y = \frac{W_u}{6A} \left[LS(3-\beta_2-\beta_3) - \frac{3KH^2}{\beta_1 S} \right] + \frac{H}{\beta_1 SA} \left[\frac{H(P_1+P_3)}{2} + KP_2 \right] \quad (\text{พ.32})$$

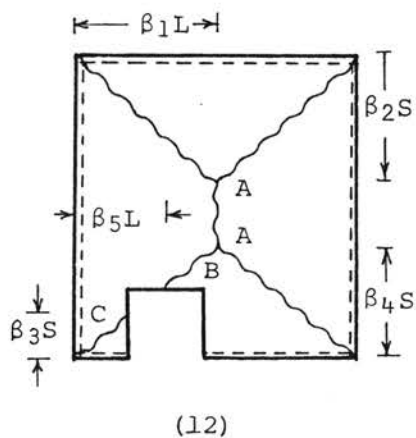
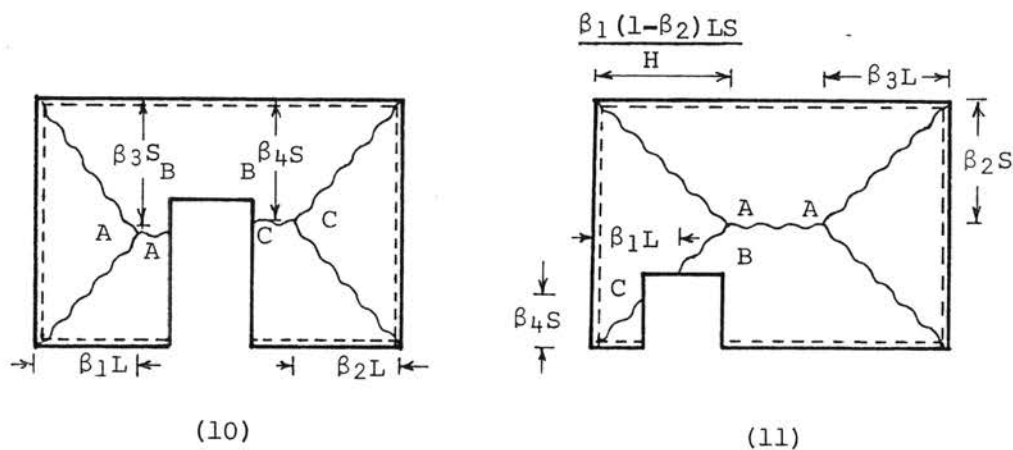
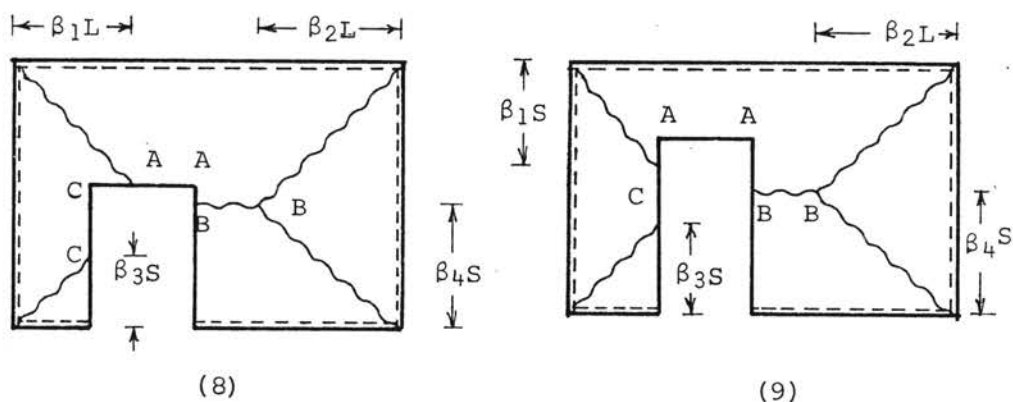
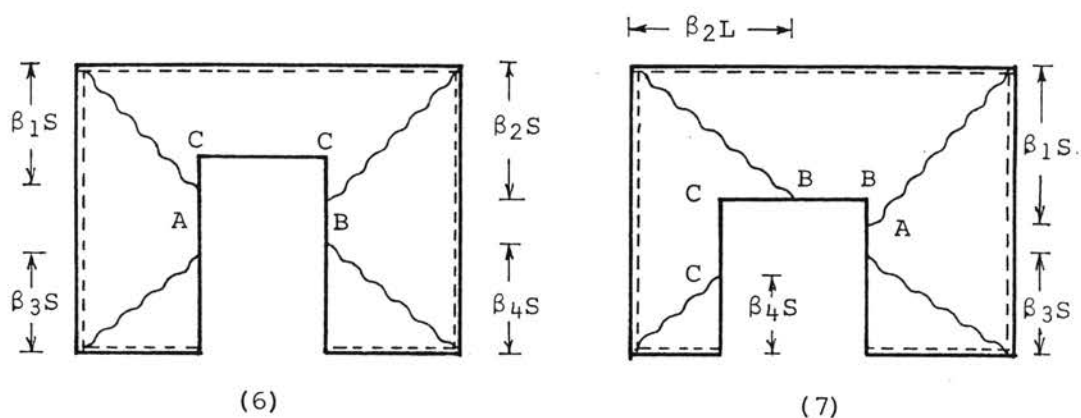
$$\text{เมื่อ } A = \frac{S}{\mu L} \left(\frac{1+i_1}{\beta_2} + \frac{1+i_3}{\beta_3} \right) + \frac{(1+i_2)L}{S(1-\beta_1)} + \frac{L+i_4(L-K)}{\beta_1 S}$$

รูปที่ พ-5(3) สมมุติให้จุด A ทรวดตัวหนึ่งหน่วย ทำให้จุด B ทรวดตัว $\frac{H}{\beta_3 S}$ หน่วย ได้ความสัมพันธ์ของแรงคัตและน้ำหนักดังสมการ (พ.33)

$$m_y = \frac{W_u}{6A} \left[LS(3-\beta_2-\beta_3) - \frac{3KH^2}{\beta_3 S} \right] + \frac{H}{\beta_3 SA} \left[\frac{H(P_1+P_3)}{2} + KP_2 \right] \quad (\text{พ.33})$$



รูปที่ พ-5 การวิบัติของแผ่นพื้นชนิดที่ 5



รูปที่ พ-5 (ต่อ) การวัดของแผ่นพื้นชนิดที่ 5

$$\text{เมื่อ } A = \frac{S}{\mu L} \left(\frac{1+i_1}{\beta_1} + \frac{1+i_3}{1-\beta_1} \right) + \frac{(1+i_2)L}{\beta_2 S} + \frac{L+i_4(L-K)}{\beta_3 S}$$

รูปที่ พ-5(4) สมมติให้จุด A ทรวดตัวหนึ่งหน่วย ทำให้จุด B และ C ทรวดตัว $\frac{X}{\beta_2 L}$ และ $\frac{(L-X-K)}{L(1-\beta_2)}$ หน่วยตามลำดับ ได้ความสัมพันธ์ของแรงดัดและน้ำหนักดั่งสมการ (พ.34)

$$\begin{aligned} m_y = & \frac{W_u}{6A} \left[3L^2 (S-H) - \beta_1 S L^2 + \frac{X^2 (3H-\beta_3 S)}{\beta_2} + \frac{(L-X-K)^2 (3H-\beta_4 S)}{(1-\beta_2)} \right] \\ & + \frac{1}{2A} \left[\frac{P_1 X (2H-\beta_3 S)}{\beta_2} + \frac{P_3 (L-X-K) (2H-\beta_4 S)}{(1-\beta_2)} \right] \\ & + P_2 \left\{ \frac{(\beta_2 L)^2 - X^2}{\beta_2} + \frac{(X+K-\beta_2 L) (2L-\beta_2 L-X-K)}{(1-\beta_2)} \right\} \quad (\text{พ.34}) \end{aligned}$$

$$\begin{aligned} \text{เมื่อ } A = & \frac{(1+i_2)L^2}{\beta_1 S} + \frac{(S-H)}{\mu \beta_2 (1-\beta_2)} + \frac{S(\beta_3+i_1)}{\mu \beta_2} + \frac{S(\beta_4+i_3)}{\mu (1-\beta_2)} \\ & + \frac{(1+i_4)}{S} \left\{ \frac{X^2}{\beta_2 \beta_3} + \frac{(L-X-K)^2}{\beta_4 (1-\beta_2)} \right\} \end{aligned}$$

รูปที่ พ-5(5) สมมติให้จุด A ทรวดตัวหนึ่งหน่วย ทำให้จุด B และ C ทรวดตัว $\frac{X}{\beta_1 L}$ และ $\frac{(L-X-K)}{\beta_2 L}$ หน่วยตามลำดับ ได้ความสัมพันธ์ของแรงดัดและน้ำหนักดั่งสมการ (พ.35)

$$\begin{aligned} m_y = & \frac{W_u}{6A} \left[L^2 (S-H) (3-\beta_1-\beta_2) + \frac{X^2 (3H-\beta_3 S)}{\beta_1} + \frac{(L-X-K)^2 (3H-\beta_4 S)}{\beta_2} \right] \\ & + \frac{1}{2A} \left[\frac{P_1 X (2H-\beta_3 S)}{\beta_1} + \frac{P_3 (L-X-K) (2H-\beta_4 S)}{\beta_2} \right] \\ & + P_2 \left\{ 2KL - \frac{(\beta_1 L-X)^2}{\beta_1} - \frac{(\beta_2 L-L+X+K)^2}{\beta_2} \right\} \quad (\text{พ.35}) \end{aligned}$$

$$\begin{aligned} \text{เมื่อ } A = & \frac{(i_2+\beta_1+\beta_2)L^2}{(S-H)} + \frac{(S-H)(\beta_1+\beta_2)}{\beta_1 \beta_2 \mu} + \frac{S}{\mu} \left(\frac{\beta_3}{\beta_1} + \frac{\beta_4}{\beta_2} \right) \\ & + \frac{S}{\mu} \left(\frac{i_1}{\beta_1} + \frac{i_3}{\beta_2} \right) + \frac{(1+i_4)}{S} \left\{ \frac{X^2}{\beta_1 \beta_3} + \frac{(L-X-K)^2}{\beta_2 \beta_4} \right\} \end{aligned}$$

รูปที่ พ-5(6) สมมุติให้จุด A ทรวดตัวหนึ่งหน่วย ทำให้จุด B และ C ทรวดตัว $\frac{\beta_2}{\beta_1}$ และ $\frac{S-H}{\beta_1 S}$ หน่วยตามลำดับ ได้ความสัมพันธ์ของแรงดัดและน้ำหนักดั่งสมการ (พ.36)

$$m_y = \frac{W}{6A} \left[SX(3-\beta_1-\beta_3) + \frac{\beta_2 S}{\beta_1} (L-X-K) (3-\beta_2-\beta_4) + \frac{3K(S-H)^2}{\beta_1 S} \right] \\ + \frac{1}{2A} \left[P_1 \left\{ 2H - \frac{(\beta_1 S - S + H)^2}{\beta_1 S} - \beta_3 S \right\} + \frac{2P_2 K(S-H)}{\beta_1 S} \right] \\ + \frac{P_3}{\beta_1} \left\{ 2\beta_2 H - \frac{(\beta_2 S - S + H)^2}{S} - \beta_2 \beta_4 S \right\} \quad (\text{พ.36})$$

$$\text{เมื่อ } A = \frac{L(1+i_2)-K}{\beta_1 S} + \frac{S(\beta_1+\beta_3+i_1)}{\mu X} + \frac{(1+i_4)}{S} \left\{ \frac{X}{\beta_3} + \frac{\beta_2(L-X-K)}{\beta_1 \beta_4} \right\} \\ + \frac{\beta_2 S(\beta_2+\beta_4+i_3)}{\mu \beta_1 (L-X-K)}$$

รูปที่ พ-5(7) สมมุติให้จุด A ทรวดตัวหนึ่งหน่วย ทำให้จุด B และ C ทรวดตัว $\frac{S-H}{\beta_1 S}$ และ $\frac{(S-H)X}{\beta_1 \beta_2 LS}$ หน่วยตามลำดับ ได้ความสัมพันธ์ของแรงดัดและน้ำหนักดั่งสมการ (พ.37)

$$m_y = \frac{W}{6\beta_1 A} \left[\beta_1 S^2 (L-X-K) (3-\beta_1-\beta_3) + (S-H)^2 (3X+3K-\beta_2 L) \right. \\ \left. + \frac{X^2 (S-H)}{\beta_2 L} (3H-\beta_4 S) \right] + \frac{1}{2\beta_1 A} \left[\frac{P_1 X}{\beta_2 L} (S-H) (2H-\beta_4 S) \right. \\ \left. + P_2 (S-H) \left\{ 2K - \frac{(\beta_2 L - X)^2}{\beta_2 L} \right\} + P_3 \left\{ 2\beta_1 SH - (\beta_1 S - S + H)^2 - \beta_1 \beta_3 S^2 \right\} \right] \quad (\text{พ.37})$$

$$\text{เมื่อ } A = \frac{(S-H)}{\mu \beta_1 \beta_2 L} \left\{ S(1+\beta_4+i_1) + \frac{(1+i_4)X^2 \mu}{\beta_4 S} - H \right\} + \frac{S^2(\beta_1+\beta_3+i_3)}{\mu(L-X-K)} \\ + \frac{(\beta_2 L + i_2 L + L - X - K)}{\beta_1} + \frac{(1+i_4)(L-X-K)}{\beta_3}$$

รูปที่ พ-5(๘) สมมุติให้จุด A ทรวดตัวหนึ่งหน่วย ทำให้จุด B และ C ทรวดตัว $\frac{S(1-\beta_4)}{S-H}$ และ $\frac{X}{\beta_1 L}$ หน่วยตามลำดับ ได้ความสัมพันธ์ของแรงคัตและน้ำหนักดั่งสมการ (พ.๓๘)

$$m_y = \frac{W}{6A} \left[(S-H)(3X+3K-\beta_1 L) + \frac{X^2}{\beta_1 L} (3H-\beta_3 S) \right. \\ \left. + \frac{S^2(1-\beta_4)}{(S-H)} \{3(L-X-K)-\beta_2 L\} + \frac{1}{2A} \left[\frac{P_1 X}{\beta_1 L} (2H-\beta_3 S) \right. \right. \\ \left. \left. + P_2 \left\{ 2K - \frac{(\beta_1 L - X)^2}{\beta_1 L} \right\} + \frac{P_3}{(S-H)} (2SH - \beta_4 S^2 - H^2) \right] \right] \quad (\text{พ.๓๘})$$

$$\text{เมื่อ } A = \frac{L(\beta_1 + i_2 + 1) - X - K}{S-H} + \frac{S(1 + \beta_3 + i_1) - F}{\mu \beta_1 L} + \frac{(1 + i_4) X^2}{\beta_1 \beta_3 L S} \\ + \frac{(1 + i_4)(L - X - K)(1 - \beta_4)}{\beta_4 (S-H)} + \frac{(1 + i_3) S^2 (1 - \beta_4)}{\mu \beta_2 L (S-H)}$$

รูปที่ พ-5(๙) สมมุติให้จุด A ทรวดตัวหนึ่งหน่วย ทำให้จุด B และ C ทรวดตัว $\frac{S(1-\beta_4)}{S-H}$ และ $\frac{\beta_1 S}{S-H}$ หน่วยตามลำดับ ได้ความสัมพันธ์ของแรงคัตและน้ำหนักดั่งสมการ (พ.๓๙)

$$m_y = \frac{W}{6A} \left[\beta_1 X S^2 (3 - \beta_1 - \beta_3) + S^2 (1 - \beta_4) \{3(L - X - K) - \beta_2 L\} + 3K(S-H)^2 \right] \\ + \frac{1}{2A} \left[P_1 \beta_1 S \left\{ 2H - \frac{(\beta_1 S - S + H)^2}{\beta_1 S} - \beta_3 S \right\} + 2P_2 K(S-H) \right. \\ \left. + P_3 \{ \beta_4 S^2 (1 - \beta_4) + (H - \beta_4 S)(2S - \beta_4 S - H) \} \right] \quad (\text{พ.๓๙})$$

$$\text{เมื่อ } A = \frac{\beta_1 S^2 (\beta_1 + \beta_3 + i_1)}{\mu X} + \frac{(1 + i_3) S^2 (1 - \beta_4)}{\beta_2 \mu L} \\ + (1 + i_4) \left\{ \frac{\beta_1 X}{\beta_3} + \frac{(L - X - K)(1 - \beta_4)}{\beta_4} \right\} + L(1 + i_2) - K$$

รูปที่ พ-5(10) สมมติให้จุด A ทรวดเดียวหนึ่งหน่วย ทำให้จุด B และ C ทรวดเดียว $\frac{S-H}{\beta_3 S}$ และ $\frac{\beta_4}{\beta_3}$ หน่วยตามลำดับ ได้ความสัมพันธ์ของแรงคัตและน้ำหนักดั่งสมการ (พ.40)

$$m_Y = \frac{W}{2A} [\beta_3 X S + \beta_4 S(L-X-K) + \frac{K}{S}(S-H)^2 - \frac{LS}{3}(\beta_1 \beta_3 + \beta_2 \beta_4)]$$

$$+ \frac{1}{2A} [P_1 \{ \beta_3 S - \frac{(S-H)^2}{S} \} + \frac{2P_2 K}{S}(S-H) + P_3 \{ \beta_4 S - \frac{(S-H)^2}{S} \}] \quad (\text{พ.40})$$

$$\text{เมื่อ } A = \frac{\beta_3 S(1+i_1)}{\beta_1 \mu L} + \frac{\beta_4 S(1+i_3)}{\beta_2 \mu L} + \frac{X(1+\beta_3 i_4)}{S(1-\beta_3)}$$

$$+ \frac{(L-X-K)(1+\beta_4 i_4)}{S(1-\beta_4)} + \frac{i_2 L}{S}$$

รูปที่ พ-5(11) สมมติให้จุด A ทรวดเดียวหนึ่งหน่วยทำให้จุด B และ C ทรวดเดียว $\frac{H}{S(1-\beta_2)}$ และ $\frac{XH}{\beta_1 L S(1-\beta_2)}$ หน่วยตามลำดับ ได้ความสัมพันธ์ของแรงคัตและน้ำหนักดั่งสมการ (พ.41)

$$m_Y = \frac{W}{6A} [\beta_2 L S^2 (1-\beta_2) \{ 3 - \frac{\beta_1 S(1-\beta_2)}{H} - \beta_3 \} + \frac{H X^2 (3H - \beta_4 S)}{\beta_1 L}]$$

$$+ \frac{2\beta_1 L}{H} (S - \beta_2 S - H)^2 (S - \beta_2 S + 2H) - 3H^2 (X + K - \beta_1 L)$$

$$+ L(S - \beta_2 S)^2 \{ 3 - \beta_3 - \frac{3\beta_1 S}{H} (1 - \beta_2) \} + 3\beta_1 L H (S - \beta_2 S - H)]$$

$$+ \frac{H}{2A} [P_3 H + P_2 \{ 2K - \frac{(\beta_1 L - X)^2}{\beta_1 L} \} + \frac{P_1 X}{\beta_1 L} (2H - \beta_4 S)] \quad (\text{พ.41})$$

$$\text{เมื่อ } A = \frac{H}{\beta_1 \mu L} [S(1+i_1 + \beta_4) + \frac{\mu X^2 (1+i_4)}{\beta_4 S} - H] + \frac{(1+i_2)(1-\beta_2)L}{\beta_2}$$

$$+ \frac{(1+i_3)(1-\beta_2)S^2}{\beta_3 \mu L} + L(1-\beta_1) + i_4(L-X-K)$$

รูปที่ พ-5(12) สมมุติให้จุด A ทอดตัวหนึ่งหน่วย ทำให้จุด B และ C ทอดตัว

$\frac{\beta_5}{\beta_1} = \frac{H}{\beta_4 S}$ และ $\frac{X}{\beta_1 L}$ หน่วยตามลำดับ ได้ความสัมพันธ์ของแรงตัดและน้ำหนักดังสมการ

(พ. 42)

$$\begin{aligned}
 m_y = & \frac{W_u}{6\beta_1 A} \left[\beta_1 L S (3 - \beta_2 - \beta_4) + \frac{(H - \beta_3 S)(\beta_5 L - X)^2}{L} - 3\beta_5 K H \right] \\
 & + \frac{1}{2\beta_1 L A} \left[P_1 X (2H - \beta_3 S) + P_2 \{ 2\beta_5 K L - (\beta_5 L - X)^2 \} \right. \\
 & \left. + P_3 \beta_5 H L \right] \qquad \qquad \qquad (\text{พ. 42})
 \end{aligned}$$

เมื่อ $\beta_5 = \frac{\beta_1 H}{\beta_4 S}$

$$\begin{aligned}
 A = & \frac{(1+i_1)S}{\beta_1 \mu L} + \frac{(1+i_3)S}{\mu L (1-\beta_1)} + \frac{(1+i_2)L}{\beta_2 S} + \frac{(1+i_4)X^2}{\beta_1 \beta_3 L S} \\
 & + \frac{i_4 (L-X-K)}{\beta_4 S} + \frac{L(1-\beta_5)}{\beta_4 S} - \frac{H-\beta_3 S}{\beta_1 \mu L}
 \end{aligned}$$

พ-6 แผ่นพื้นชนิดที่ 6

รูปที่ พ-6(1) แสดงตำแหน่งช่องเปิดขนาดใด ๆ อยู่ตรงกลางของแผ่นพื้น รับน้ำหนักแนวเส้นรอบช่องเปิดและแรงดัดชนิดลบที่ขอบที่รองรับของแผ่นพื้น มีการสมมาตรสองทิศทาง โอกาสที่จะเกิดรูปแบบยิลด์ไลน์มีอยู่ 4 รูปแบบด้วยกัน

รูปที่ พ-6(2) สมมุติให้จุด A ทอดตัวหนึ่งหน่วย ทำให้จุด B ทอดตัว $\frac{S-H}{S}$ หน่วย ได้สมการพลังงานดังสมการ (พ.43), (พ.44) และ (พ.45)

$$W_{eu} = \frac{W}{6S} [LS^2(3-2\beta) - 3KH(2S-H)] \quad (\text{พ.43})$$

$$W_{el} = \frac{1}{S} [2P_2K(S-H) + P_1H(2S-H)] \quad (\text{พ.44})$$

$$W_i = \frac{2m}{S} \left[\frac{(1+i_1)S^2}{\beta\mu L} + 2(1+i_2)L - 2K \right] \quad (\text{พ.45})$$

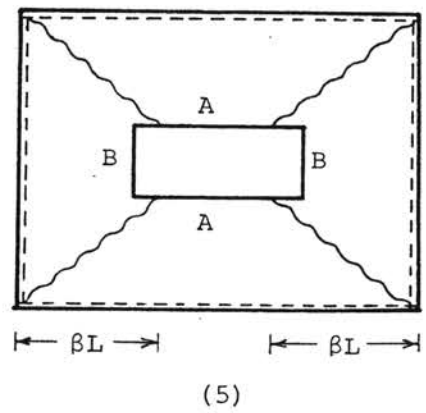
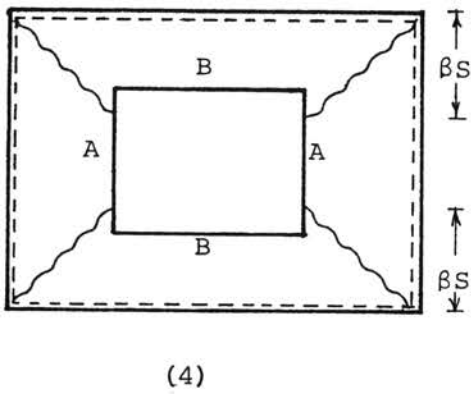
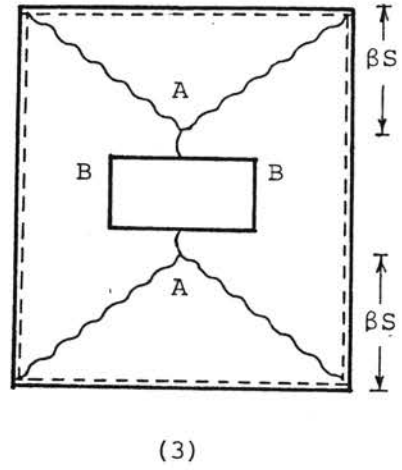
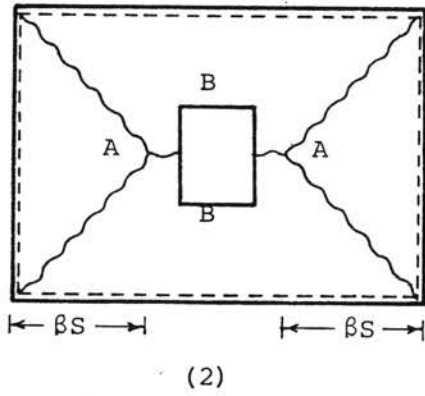
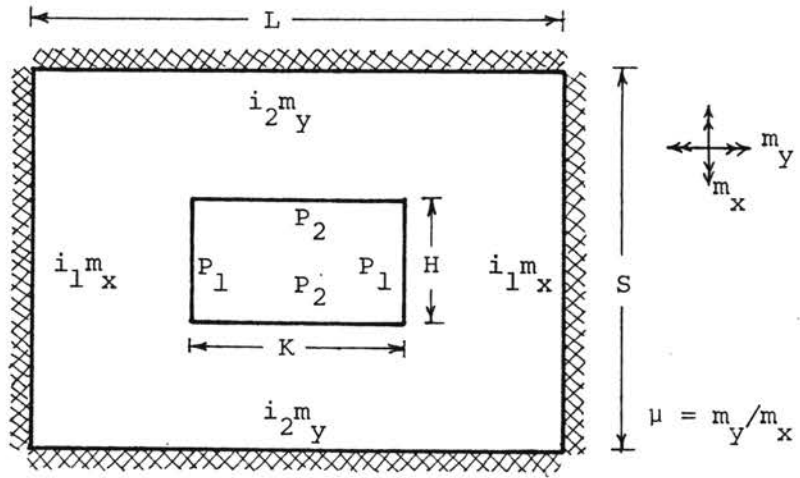
จาก $W_i = W_{eu} + W_{el}$ ได้ความสัมพันธ์ของแรงดัดกับน้ำหนักดังสมการ (พ.46)

$$m_y = \frac{W}{6A} [LS^2(3-2\beta) - 3KH(2S-H)] + \frac{1}{A} [2P_2K(S-H) + P_1H(2S-H)] \quad (\text{พ.46})$$

$$\text{เมื่อ } A = \frac{2S^2(1+i_1)}{\beta\mu L} + 4L(1+i_2) - 4K$$

รูปที่ พ-6(3) สมมุติให้จุด A ทอดตัวหนึ่งหน่วย ทำให้จุด B ทอดตัว $\frac{(L-K)}{L}$ หน่วย ได้ความสัมพันธ์ของแรงดัดและน้ำหนักดังสมการ (พ.47)

$$m_y = \frac{W}{6A} [L^2S(3-2\beta) - 3KH(2L-K)] + \frac{1}{A} [2P_1H(L-K) + P_2K(2L-K)] \quad (\text{พ.47})$$



รูปที่ พ-6 การวิบัติของแผ่นพื้นชนิดที่ 6

$$\text{เมื่อ } A = \frac{2(1+i_2)L^2}{\beta S} + \frac{4S(1+i_1)}{\mu} - \frac{4H}{\mu}$$

รูปที่ พ-6(4) สมมติให้จุด A ทรวดเดียวหนึ่งหน่วย ทำให้จุด B ทรวดเดียว $\frac{(S-H)}{2\beta S}$ หน่วย
 ได้ความสัมพันธ์ของแรงดัดและน้ำหนักดั่งสมการ (พ. 48)

$$m_y = \frac{W_u}{6A} [\beta S^2 (L-K) (6-4\beta) + 3K(S-H)^2] \\ + \frac{1}{A} [2P_2 K(S-H) + P_1 \{4\beta SH - (2\beta S - S + H)^2\}] \quad (\text{พ. 48})$$

$$\text{เมื่อ } A = \frac{8\beta S^2 (i_1 + 2\beta)}{\mu (L-K)} + 4\{L(i_2 + 1) - K\}$$

รูปที่ พ-6(5) สมมติให้จุด A ทรวดเดียวหนึ่งหน่วย ทำให้จุด B ทรวดเดียว $\frac{(L-K)}{2\beta L}$ หน่วย
 ได้ความสัมพันธ์ของแรงดัดและน้ำหนักดั่งสมการ (พ. 49)

$$m_y = \frac{W_u}{6A} [\beta L^2 (S-H) (6-4\beta) + 3H(L-K)^2] \\ + \frac{1}{A} [2P_1 H(L-K) + P_2 \{4\beta LK - (2\beta L - L + K)^2\}] \quad (\text{พ. 49})$$

$$\text{เมื่อ } A = \frac{8\beta L^2 (i_2 + 2\beta)}{S-H} + \frac{4}{\mu} \{S(i_1 + 1) - H\}$$

พ.7 แผ่นพื้นชนิดที่ 7

รูปที่ พ-7(1) แสดงตำแหน่งทั่ว ๆ ไปของช่องเปิดขนาดใด ๆ อยู่ภายในแผ่นพื้น โดยที่ระยะ X น้อยกว่าหรือเท่ากับระยะ L-X-K และระยะ Y น้อยกว่าหรือเท่ากับระยะ S-Y-H แผ่นพื้นไม่มีการสมมาตรใด ๆ โอกาสที่จะเกิดรูปแบบยึดคัลไลน์มีอยู่ 16 รูปแบบด้วยกัน

รูปที่ พ-7(2) สมมุติให้จุด A ทอดตัวหนึ่งหน่วย ทำให้จุด B และ C ทอดตัว $\frac{Y}{\beta_3 S}$ และ $\frac{(S-Y-H)}{S(1-\beta_3)}$ หน่วยตามลำดับ ได้สมการของพลังงานดังสมการ (พ.50), (พ.51) และ (พ.52)

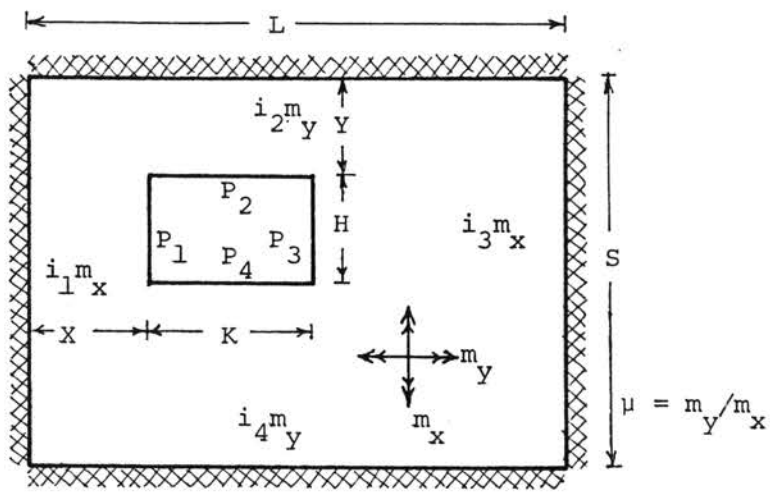
$$W_{eu} = \frac{W_u^K}{2S} \left[\frac{LS^2}{3K} (2-\beta_1-\beta_2) + \frac{(Y+H-\beta_3 S)(Y+H+\beta_3 S-2S)}{1-\beta_3} + \frac{Y^2 - \beta_3^2 S^2}{\beta_3} \right] \quad (\text{พ.50})$$

$$W_{el} = \frac{1}{2S} \left[2K \left\{ \frac{P_2 Y}{\beta_3} + \frac{P_4 (S-Y-H)}{1-\beta_3} \right\} + (P_1 + P_3) \left\{ \frac{\beta_3^2 S^2 - Y^2}{\beta_3} + \frac{(Y+H-\beta_3 S)(2S-Y-H-\beta_3 S)}{1-\beta_3} \right\} \right] \quad (\text{พ.51})$$

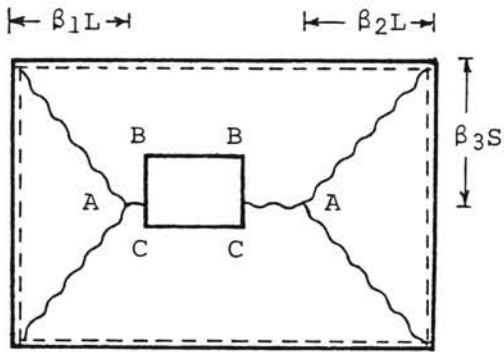
$$W_i = \frac{m_y}{S} \left[\frac{S^2}{\mu L} \left(\frac{1+i_1}{\beta_1} + \frac{1+i_3}{\beta_2} \right) + \frac{(1+i_2)L}{\beta_3} + \frac{(1+i_4)L}{1-\beta_3} - \frac{K}{\beta_3(1-\beta_3)} \right] \quad (\text{พ.52})$$

จาก $W_i = W_{eu} + W_{el}$ ได้ความสัมพันธ์ของแรงดัดกับน้ำหนักดังสมการ (พ.53)

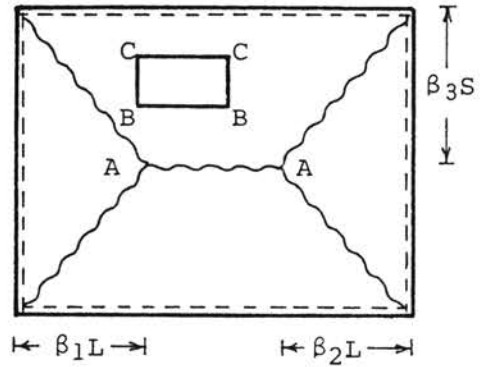
$$m_y = \frac{W_u^K}{2A} \left[\frac{LS^2}{3K} (3-\beta_1-\beta_2) - \frac{(Y+H-\beta_3 S)(2S-Y-H-\beta_3 S)}{1-\beta_3} + \frac{\beta_3^2 S^2 - Y^2}{\beta_3} \right] + \frac{1}{2A} \left[2K \left\{ \frac{P_2 Y}{\beta_3} + \frac{P_4 (S-Y-H)}{1-\beta_3} \right\} + (P_1 + P_3) \left\{ \frac{\beta_3^2 S^2 - Y^2}{\beta_3} + \frac{(Y+H-\beta_3 S)(2S-Y-H-\beta_3 S)}{1-\beta_3} \right\} \right] \quad (\text{พ.53})$$



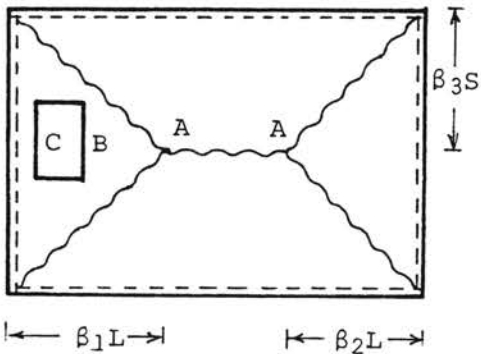
(1)



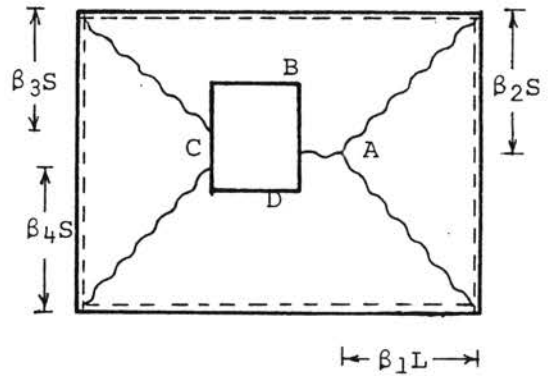
(2)



(3)

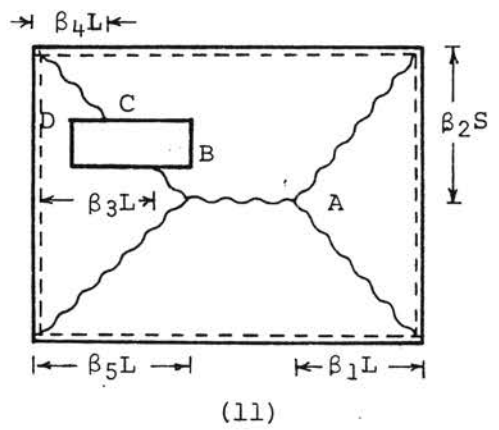
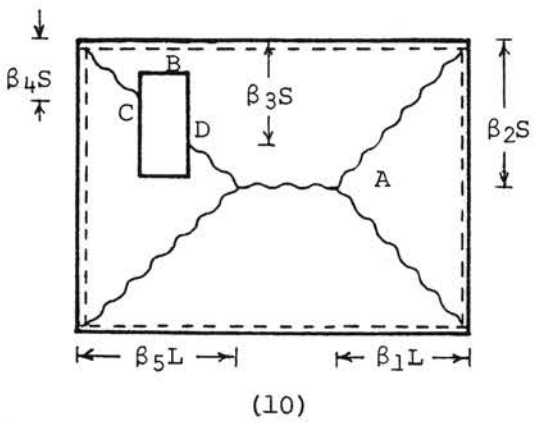
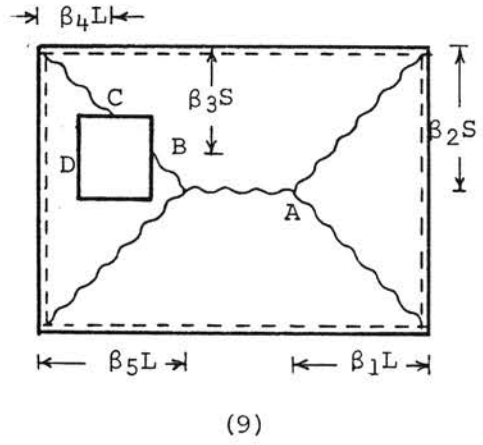
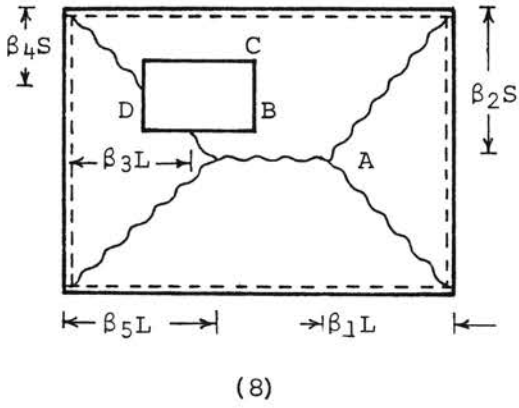
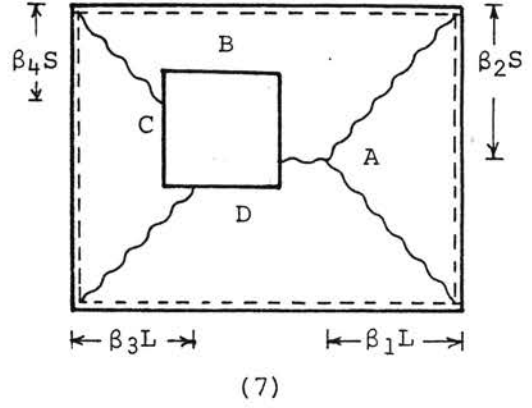
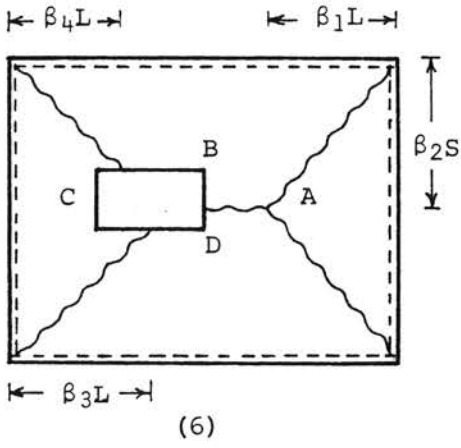


(4)

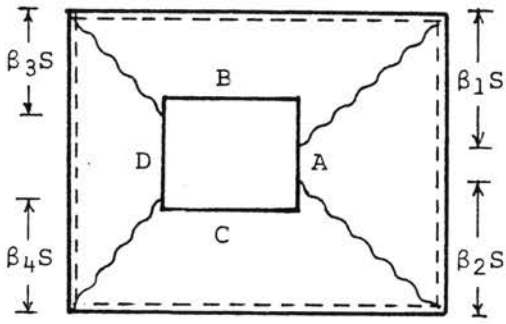


(5)

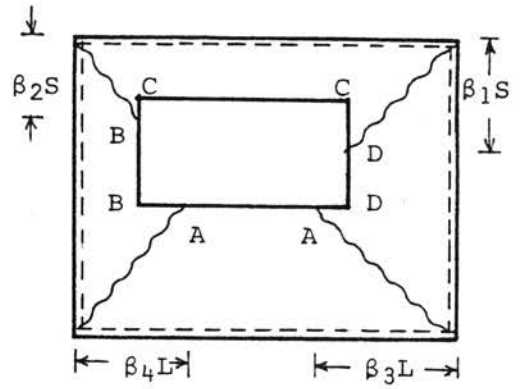
รูปที่ พ-7 การวิบัติของแผ่นพื้นชนิดที่ 7



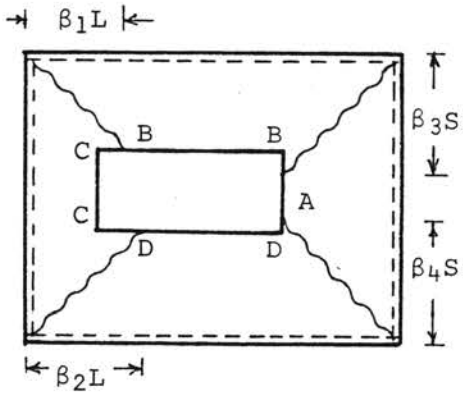
รูปที่ พ-7 (ต่อ) การวัดของแผ่นพื้นชนิดที่ 7



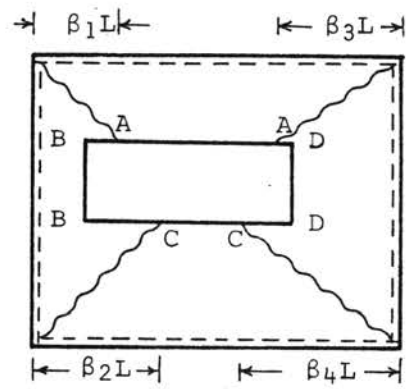
(12)



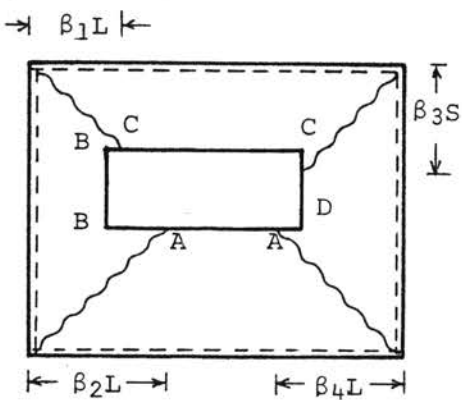
(13)



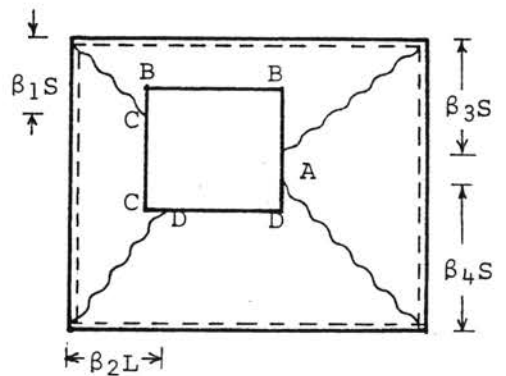
(14)



(15)



(16)



(17)

$$\text{เมื่อ } A = \frac{S^2}{\mu L} \left(\frac{1+i_1}{\beta_1} + \frac{1+i_3}{\beta_2} \right) + \frac{(1+i_2)L}{\beta_3} + \frac{(1+i_4)L}{1-\beta_3} - \frac{K}{\beta_3(1-\beta_3)}$$

รูปที่ พ-7(3) สมมุติให้จุด A ทรวดตัวหนึ่งหน่วย ทำให้จุด B และ C ทรวดตัว

$$\frac{(Y+H)}{\beta_3 S} \text{ และ } \frac{Y}{\beta_3 S} \text{ หน่วยตามลำดับ ได้ความสัมพันธ์ของแรงดัดกับน้ำหนักตั้งสมการ (พ.54)}$$

$$m_Y = \frac{W}{6A} \left[LS(3-\beta_1-\beta_2) - \frac{3KH(2Y+H)}{\beta_3 S} \right] + \frac{1}{2\beta_3 SA} \left[H(2Y+H)(P_1+P_3)+2K \right] P_2 Y + P_4 (Y+H) \quad (\text{พ.54})$$

$$\text{เมื่อ } A = \frac{(1+i_4)L}{S(1-\beta_3)} + \frac{(1+i_3)S}{\beta_3 \mu L} + \frac{(1+i_1)S}{\beta_1 \mu L} + \frac{(1+i_2)L}{\beta_3 S}$$

รูปที่ พ-7(4) สมมุติให้จุด A ทรวดตัวหนึ่งหน่วย ทำให้จุด B และ C ทรวดตัว $\frac{(X+K)}{\beta_1 L}$

$$\text{และ } \frac{X}{\beta_1 L} \text{ หน่วยตามลำดับ ได้ความสัมพันธ์ของแรงดัดกับน้ำหนักตั้งสมการ (พ.55)}$$

$$m_Y = \frac{W}{6A} \left[LS(3-\beta_1-\beta_2) - \frac{3KH(2X+K)}{\beta_1 L} \right] + \frac{1}{2\beta_1 LA} \left[K(2X+K)(P_2+P_4)+2H \right] P_1 X + P_3 (X+K) \quad (\text{พ.55})$$

$$\text{เมื่อ } A = \frac{S}{\mu L} \left(\frac{1+i_1}{\beta_1} + \frac{1+i_3}{\beta_2} \right) + \frac{L}{S} \left(\frac{1+i_2}{\beta_3} + \frac{1+i_4}{1-\beta_3} \right)$$

รูปที่ พ-7(5) สมมุติให้จุด A ทรวดตัวหนึ่งหน่วย ทำให้จุด B, C และ D ทรวดตัว

$$\frac{Y}{\beta_2 S}, \frac{\beta_3}{\beta_2} \text{ และ } \frac{\beta_3(S-Y-H)}{\beta_2 \beta_4 S} = \frac{(S-Y-H)}{S(1-\beta_2)} \text{ หน่วยตามลำดับ ได้ความสัมพันธ์ของแรงดัดกับน้ำหนัก}$$

ตั้งสมการ (พ.56)

$$m_Y = \frac{W}{6A} \left[\beta_2 S^2 \{ 3(L-X-K) - \beta_1 L \} + \beta_3 X S^2 (3-\beta_3-\beta_4) + 3KY^2 \right. \\ \left. + \frac{3\beta_3 K}{\beta_4} (S-Y-H)^2 \right] + \frac{1}{2A} \left[P_1 \beta_3 \left\{ 2HS - \frac{(\beta_4 S - S + Y + H)^2}{\beta_4} \right\} \right. \\ \left. - P_1 (\beta_3 S - Y)^2 + P_3 (\beta_2^2 S^2 - Y^2) + \frac{2P_4 \beta_3 K}{\beta_4} (S-Y-H) \right]$$

$$+ P_3(Y+H-\beta_3S) \left\{ \beta_2S + \frac{\beta_3}{\beta_4}(S-Y-H) \right\} + 2P_2KY] \quad (\text{พ.56})$$

$$\text{เมื่อ } \beta_4 = \frac{\beta_3(1-\beta_2)}{\beta_2}$$

$$A = \frac{\beta_3S^2(i_1+\beta_3+\beta_4)}{\mu X} + \frac{\beta_2S^2(1+i_3)}{\beta_1 \mu L} \\ + \frac{\beta_2\{(1+i_4)L-K\}}{1-\beta_2} + (1+i_2)L-K$$

รูปที่ พ-7(6) สมมติให้จุด A ทอดตัวหนึ่งหน่วย ทำให้จุด B, C และ D ทอดตัว $\frac{Y}{\beta_2S}$, $\frac{XY}{\beta_2\beta_4LS}$ และ $\frac{\beta_3Y}{\beta_2\beta_4S} = \frac{(S-Y-H)}{S(1-\beta_2)}$ หน่วยตามลำดับ ได้ความสัมพันธ์ของแรงตัด กับน้ำหนักตั้งสมการ (พ.57)

$$m_Y = \frac{W}{6A} [\beta_2S^2\{3(L-X-K)-\beta_1L\} + Y^2\{3(X+K)-\beta_4L\}] \\ + \frac{\beta_3Y}{\beta_4} (S-Y-H) \left\{ 3(X+K)-\beta_3L \right\} + \frac{3HYX^2}{\beta_4L} \\ + \frac{1}{2A} \left[\frac{Y}{\beta_4L} \{ 2P_1HX - P_2(\beta_4L-X)^2 - P_4(\beta_3L-X)^2 \} \right. \\ \left. + 2KY(P_2 + \frac{P_4\beta_3}{\beta_4}) + P_3 \left\{ (Y+H) \left(\beta_2S + \frac{\beta_3Y}{\beta_4} \right) - \frac{\beta_2\beta_3YS}{\beta_4} - Y^2 \right\} \right] \quad (\text{พ.57})$$

$$\text{เมื่อ } \beta_3 = \frac{\beta_2\beta_4(S-Y-H)}{Y(1-\beta_2)}$$

$$A = \frac{1}{\mu L} \left\{ \frac{\beta_2S^2(1+i_3)}{\beta_1} + \frac{Y(S+i_1S-H)}{\beta_4} \right\} + \frac{\beta_2L(1+i_4) - \beta_2(X+K - \beta_3L)}{1-\beta_2} \\ + (1+i_2)L + \beta_4L - X - K$$

รูปที่ พ-7(7) สมมติให้จุด A ทรวดตัวหนึ่งหน่วย ทำให้จุด B, C และ D ทรวดตัว $\frac{Y}{\beta_2 S}$, $\frac{\beta_4}{\beta_2}$ และ $\frac{(S-Y-H)}{S(1-\beta_2)} = \frac{\beta_3 \beta_4 L}{\beta_2 X}$ หน่วยตามลำดับ ได้ความสัมพันธ์ของแรงดัดกับน้ำหนัก
ตั้งสมการ (พ.58)

$$\begin{aligned}
 m_Y &= \frac{W}{6A} \left[S \{ 3(L-X-K) - \beta_1 L \} + \frac{3KY^2}{\beta_2 S} + \frac{\beta_4 X}{\beta_2} \{ 3((Y+H) - \beta_4 S) \right. \\
 &+ \frac{\beta_3 \beta_4 L (S-Y-H) (3X+3K-\beta_3 L)}{\beta_2 X} \left. + \frac{1}{2\beta_2 A} \left[\frac{Y}{S} (2P_2 K - P_3 Y) \right. \right. \\
 &+ \frac{P_1}{S} \{ 2\beta_4 HS - (\beta_4 S - Y)^2 \} + \frac{P_4 \beta_4}{X} \{ 2\beta_3 KL - (\beta_3 L - X)^2 \} \\
 &\left. \left. + P_3 \{ \beta_2^2 S + \frac{(Y+H-\beta_2 S) (\beta_2 X + \beta_3 \beta_4 L)}{X} \} \right] \right] \quad (\text{พ.58})
 \end{aligned}$$

$$\text{เมื่อ } \beta_3 = \frac{\beta_2 X (S-Y-H)}{\beta_4 L S (1-\beta_2)}$$

$$\begin{aligned}
 A &= \frac{(1+i_3)S}{\beta_1 \mu L} + \frac{(L+i_2 L-K)}{\beta_2 S} + \frac{L(1+i_4 + \beta_3) - K - X}{S(1-\beta_2)} \\
 &+ \frac{\{S(1+i_1 + \beta_4) - H - Y\} \beta_4}{\beta_2 \mu X}
 \end{aligned}$$

รูปที่ พ-7(8) สมมติให้จุด A ทรวดตัวหนึ่งหน่วย ทำให้จุด B, C และ D ทรวดตัว $\frac{(Y+H)}{\beta_2 S}$, $\frac{Y}{\beta_2 S}$ และ $\frac{\beta_4}{\beta_2} = \frac{(Y+H)X}{\beta_2 \beta_3 LS}$ หน่วยตามลำดับ ได้ความสัมพันธ์ของแรงดัดกับน้ำหนัก
ตั้งสมการ (พ.59)

$$\begin{aligned}
 m_Y &= \frac{W}{6A} \left[\beta_2 L S^2 (3-\beta_1 - \beta_5) - 3KH(2Y+H) + (\beta_3 L - X) (Y+H - \beta_4 S)^2 \right] \\
 &+ \frac{1}{2A} \left[2P_2 KY + P_1 \{ 2\beta_4 HS - (\beta_4 S - Y)^2 \} + P_4 \{ 2K(Y+H) \right. \\
 &\left. - (\beta_3 L - X) (Y+H - \beta_4 S) \} + P_3 H(2Y+H) \right] \quad (\text{พ.59})
 \end{aligned}$$

$$\text{เมื่อ } \beta_4 = \frac{X(Y+H)}{\beta_3LS}$$

$$\beta_5 = \frac{\beta_2\beta_3S}{Y+H}$$

$$A = \frac{\beta_2S}{\beta_5\mu L} \{S(1+i_1+\beta_4)-Y-H\} + \frac{\beta_2S^2(1+i_3)}{\beta_1\mu L} \\ + \frac{\beta_2L(1+i_4)}{1-\beta_2} + L(1+i_2)+X-\beta_3L$$

รูปที่ พ-7(๑) สมมติให้จุด A ทรวดตัวหนึ่งหน่วย ทำให้จุด B, C และ D ทรวดตัว $\frac{\beta_3}{\beta_2}$, $\frac{Y}{\beta_2S}$ และ $\frac{XY}{\beta_2\beta_4LS} = \frac{\beta_3X}{\beta_2(X+K)}$ หน่วยตามลำดับ ได้ความสัมพันธ์ของแรงดัดกับน้ำหนัก ดังสมการ (พ.๖๐)

$$m_Y = \frac{W}{6A} \left[\beta_2LS^2(3-\beta_1-\beta_5) - 3KH(\beta_3S + \frac{XY}{\beta_4L}) + (X+K-\beta_4L)(\beta_3S-Y)^2 \right] \\ + \frac{1}{2A} \left[\frac{2P_1HXY}{\beta_4L} + P_4K(\beta_3S + \frac{XY}{\beta_4L}) + P_2Y \left\{ 2K - \frac{(\beta_4L-X)^2}{\beta_4L} \right\} \right] \\ + P_3 \{ 2\beta_3HS - (\beta_3S-Y)^2 \} \quad (\text{พ.๖๐})$$

$$\text{เมื่อ } \beta_4 = \frac{Y(X+K)}{\beta_3LS}$$

$$\beta_5 = \frac{\beta_2(X+K)}{\beta_3L}$$

$$A = \frac{\beta_2S}{\beta_5\mu L} \{S(1+i_1-\beta_3)+Y\} + \frac{\beta_2S^2(1+i_3)}{\beta_1\mu L} + \frac{\beta_2L(1+i_4)}{1-\beta_2} \\ + L(1+i_2)+\beta_4L-X-K$$

รูปที่ พ-7(10) สมมติให้จุด A ทอดตัวหนึ่งหน่วย ทำให้จุด B, C และ D ทอดตัว $\frac{Y}{\beta_2 S}$, $\frac{\beta_4}{\beta_2}$ และ $\frac{\beta_3}{\beta_2} = \frac{(X+K)}{\beta_5 L}$ หน่วยตามลำดับ ได้ความสัมพันธ์ของแรงดัดกับน้ำหนักดั่งสมการ (พ.61)

$$m_y = \frac{W_u}{6A} [\beta_2 L S^2 (3-\beta_1-\beta_5) - 2KS(Y+H-\beta_3 S) (\beta_3+\beta_4) - 3K(\beta_4^2 S^2 - Y^2) - 2KS^2 (\beta_3-\beta_4) (\beta_3+2\beta_4)] + \frac{1}{2A} [2P_2 KY + P_4 KS (\beta_3+\beta_4) + P_1 \{2\beta_4 HS - (\beta_4 S - Y)^2\} + P_3 \{2\beta_3 HS - (\beta_3 S - Y)^2\}] \quad (\text{พ.61})$$

$$\text{เมื่อ } \beta_4 = \frac{\beta_3 X}{X+K}$$

$$\beta_5 = \frac{\beta_2 (X+K)}{\beta_3 L}$$

$$A = \frac{\beta_2 S^2}{\beta_5 \mu L} (1+i_1 - \beta_3 + \beta_4) + \frac{\beta_2 S^2 (1+i_3)}{\beta_1 \mu L} + \frac{\beta_2 L (1+i_4)}{1-\beta_2} + L(1+i_2) - K$$

รูปที่ พ-7(11) สมมติให้จุด A ทอดตัวหนึ่งหน่วย ทำให้จุด B, C และ D ทอดตัว $\frac{\beta_3}{\beta_5}$, $\frac{\beta_4}{\beta_5}$ และ $\frac{X}{\beta_5 L}$ หน่วยตามลำดับ ได้ความสัมพันธ์ของแรงดัดกับน้ำหนักดั่งสมการ (พ.62)

$$m_y = \frac{W_u}{6\beta_5 LA} [\beta_5 S L^2 (3-\beta_1-\beta_5) - 3HL(X+K-\beta_3 L) (\beta_3+\beta_4) - 3H(\beta_4^2 L^2 - X^2) - 2HL^2 (\beta_3-\beta_4) (\beta_3+2\beta_4)]$$

$$\begin{aligned}
& + \frac{1}{2\beta_5 LA} [2P_1HX + P_3HL(\beta_3 + \beta_4) + P_2\{2\beta_4KL - (\beta_4L - X)^2\} \\
& + P_4\{2\beta_3KL - (\beta_3L - X)^2\}] \quad (\text{พ.62})
\end{aligned}$$

$$\text{เมื่อ } \beta_4 = \frac{\beta_3 Y}{Y+H}$$

$$\beta_5 = \frac{\beta_2 \beta_3 S}{Y+H}$$

$$\begin{aligned}
A = & \frac{S(1+i_1) - H}{\beta_5 \mu L} + \frac{L(1+i_2 - \beta_3 + \beta_4)}{\beta_2 S} + \frac{S(1+i_3)}{\beta_1 \mu L} \\
& + \frac{L(1+i_4)}{S(1-\beta_2)}
\end{aligned}$$

รูปที่ พ-7 (12) สมมติให้จุด A ทรวดตัวหนึ่งหน่วย ทำให้จุด B, C และ D ทรวดตัว $\frac{Y}{\beta_1 S}$, $\frac{(S-Y-H)}{\beta_2 S}$ และ $\frac{\beta_3}{\beta_1} = \frac{\beta_4}{\beta_2}$ หน่วยตามลำดับ ได้ความสัมพันธ์ของแรงดัดกับน้ำหนักตั้ง สมการ (พ.63)

$$\begin{aligned}
m_Y = & \frac{W}{6A} [\beta_3 X S^2 (3 - \beta_3 - \beta_4) + \beta_1 S^2 (L - X - K) (3 - \beta_1 - \beta_2) \\
& + 3K\{Y^2 + \frac{\beta_1}{\beta_2} (S - Y - H)^2\}] + \frac{1}{2A} [P_1\{2\beta_3 HS - (\beta_3 S - Y)^2 \\
& - \frac{\beta_1}{\beta_2} (\beta_4 S - S + Y + H)^2\} + P_3\{2\beta_1 HS - (\beta_1 S - Y)^2 - \frac{\beta_1}{\beta_2} (\beta_2 S - S + Y + H)^2\} \\
& + 2K\{P_2 Y + \frac{P_4 \beta_1}{\beta_2} (S - Y - H)\}] \quad (\text{พ.63})
\end{aligned}$$

$$\text{เมื่อ } \beta_2 = \frac{\beta_1 \beta_4}{\beta_3}$$

$$A = \frac{\beta_1 S^2 (\beta_1 + \beta_2 + i_3)}{\mu (L - X - K)} + \frac{\beta_3 S^2 (\beta_3 + \beta_4 + i_1)}{\mu X}$$

$$+ \frac{\beta_1}{\beta_2} (L-K+i_4L)+L+i_2L-K$$

รูปที่ พ-7 (13) สมมุติให้จุด A ทรวดตัวหนึ่งหน่วย ทำให้จุด B, C และ D ทรวดตัว $\frac{X}{\beta_4L}$, $\frac{XY}{\beta_2\beta_4LS}$ และ $\frac{\beta_1X}{\beta_2\beta_4L} = \frac{(L-X-K)}{\beta_3L}$ หน่วยตามลำดับ ได้ความสัมพันธ์ของแรงตัดกับ น้ำหนักตั้งสมการ (พ.64)

$$\begin{aligned} m_y &= \frac{W}{6A} [\beta_4L^2 (S-Y-H) (3-\beta_3-\beta_4) + \frac{\beta_1X}{\beta_2} (L-X-K) (3Y+3H-\beta_1S) \\ &+ X^2 (3Y+3H-\beta_2S) + \frac{3KXY^2}{\beta_2S}] + \frac{1}{2A} [P_1 X \{ 2H - \frac{(\beta_2S-Y)^2}{\beta_2S} \} \\ &+ P_3 X \{ \frac{2\beta_1H}{\beta_2} - \frac{(\beta_1S-Y)^2}{\beta_2S} \} + P_4 \{ 2\beta_4KL - (\beta_4L-X)^2 - \frac{\beta_4}{\beta_3} (\beta_3L \\ &- L+X+K)^2 \} + \frac{2P_2 KXY}{\beta_2S}] \end{aligned} \quad (\text{พ.64})$$

$$\text{เมื่อ } \beta_3 = \frac{\beta_2\beta_4 (L-X-K)}{\beta_1X}$$

$$\begin{aligned} A &= \frac{S(1+i_1\beta_2)-Y-H}{\mu} + \frac{XL(1+i_2)-KX}{\beta_2S} \\ &+ \frac{\beta_4\{S(1+i_3+\beta_1)-Y-H\}}{\beta_3\mu} + \frac{\beta_4L^2(i_4+\beta_3+\beta_4)}{S-Y-H} \end{aligned}$$

รูปที่ พ-7 (14) สมมุติให้จุด A ทรวดตัวหนึ่งหน่วย ทำให้จุด B, C และ D ทรวดตัว $\frac{Y}{\beta_3S}$, $\frac{XY}{\beta_1\beta_3LS}$ และ $\frac{\beta_2Y}{\beta_1\beta_3S} = \frac{(S-Y-H)}{\beta_4S}$ หน่วยตามลำดับ ได้ความสัมพันธ์ของแรงตัดกับ น้ำหนักตั้งสมการ (พ.65)

$$\begin{aligned} m_y &= \frac{W}{6A} [\beta_3S^2 (L-X-K)(3-\beta_3-\beta_4) + Y^2 (3X+3K-\beta_1L) \\ &+ \frac{\beta_2Y}{\beta_1} (S-Y-H) (3X+3K-\beta_2L) + \frac{3HYX^2}{\beta_1L}] \end{aligned}$$

$$\begin{aligned}
& + \frac{1}{2A} \left[\frac{2P_1 HXY}{\beta_1 L} + P_2 Y \left\{ 2K - \frac{(\beta_1 L - X)^2}{\beta_1 L} \right\} + \frac{P_4 Y}{\beta_1} \left\{ 2\beta_2 K - \frac{(\beta_2 L - X)^2}{L} \right\} \right. \\
& \left. + P_3 \beta_3 \left\{ 2HS - \frac{(\beta_3 S - Y)^2}{\beta_3} + \frac{(\beta_4 S - S + Y + H)^2}{\beta_4} \right\} \right] \quad (\text{พ.65})
\end{aligned}$$

$$\text{เมื่อ } \beta_4 = \frac{\beta_1 \beta_3 (S - Y - H)}{\beta_2 Y}$$

$$\begin{aligned}
A & = \frac{YS(1+i_1) - HY}{\beta_1 \mu L} + \frac{\beta_3 \{L(1+i_4 + \beta_2) - X - K\}}{\beta_4} \\
& + \frac{\beta_3 S^2 (i_3 + \beta_3 + \beta_4)}{\mu (L - X - K)} + \frac{L(1+i_2 + \beta_1) - X - K}{\mu}
\end{aligned}$$

รูปที่ พ-7(15) สมมติให้จุด A ทรวดเดียวหนึ่งหน่วย ทำให้จุด B, C และ D ทรวดเดียว
 $\frac{X}{\beta_1 L}$, $\frac{\beta_2}{\beta_1}$ และ $\frac{(L-X-K)}{\beta_3 L} = \frac{\beta_2 (L-X-K)}{\beta_1 \beta_4 L}$ หน่วยตามลำดับ ได้ความสัมพันธ์ของแรงดัดกับ
 น้ำหนักดั่งสมการ (พ.66)

$$\begin{aligned}
m_y & = \frac{W}{6A} \left[\beta_1 Y L^2 (3 - \beta_1 - \beta_3) + \beta_2 L^2 (S - Y - H) (3 - \beta_2 - \beta_4) \right. \\
& + \frac{3\beta_1 H}{\beta_2} (L - X - K)^2 + 3HX^2 \left. \right] + \frac{1}{2A} \left[2P_1 HX + \frac{2P_3 \beta_1 H (L - X - K)}{\beta_3} \right. \\
& + P_2 \left\{ 2\beta_1 KL - (\beta_1 L - X)^2 - \frac{\beta_1}{\beta_3} (\beta_3 L - L + X + K)^2 \right\} \\
& + P_4 \left\{ 2\beta_2 KL - (\beta_2 L - X)^2 - \frac{\beta_2}{\beta_4} (\beta_4 L - L + X + K)^2 \right\} \left. \right] \quad (\text{พ.66})
\end{aligned}$$

$$\text{เมื่อ } \beta_4 = \frac{\beta_2 \beta_3}{\beta_1}$$

$$\begin{aligned}
A & = \frac{S(1+i_1) - H}{\mu} + \frac{\beta_1 L^2 (i_2 + \beta_1 + \beta_3)}{Y} + \frac{\beta_1 (S - i_3 S - H)}{\beta_3 \mu} \\
& + \frac{\beta_2 L^2 (i_4 + \beta_2 + \beta_4)}{S - Y - H}
\end{aligned}$$

รูปที่ พ-7(16) สมมุติให้จุด A ทรวดตัวหนึ่งหน่วย ทำให้จุด B, C และ D ทรวดตัว $\frac{X}{\beta_2 L}$, $\frac{\beta_1}{\beta_2}$ และ $\frac{\beta_1 \beta_3 S}{\beta_2 Y} = \frac{(L-X-K)}{\beta_4 L}$ หน่วยตามลำดับ ได้ความสัมพันธ์ของแรงดัดกับน้ำหนัก ดังสมการ (พ.67)

$$\begin{aligned}
 m_Y &= \frac{W_u}{6A} [\beta_2 L^2 (S-Y-H) (3-\beta_2-\beta_4) + \beta_1 Y L (3X+3K-\beta_1 L) \\
 &+ \frac{\beta_2}{\beta_4} (L-X-K)^2 (3Y+3H-\beta_3 S) + 3HX^2] \\
 &+ \frac{1}{2A} [2P_1 HX + P_2 \{2\beta_1 KL - (\beta_1 L - X)^2\} + \frac{P_3 \beta_1 L}{Y} \{2\beta_3 HS \\
 &- (\beta_3 S - Y)^2\} + P_4 \{2\beta_2 KL - (\beta_2 L - X)^2 - \frac{\beta_2}{\beta_4} (\beta_4 L - L + X + K)^2\}] \quad (\text{พ.67})
 \end{aligned}$$

$$\text{เมื่อ } \beta_4 = \frac{\beta_2 Y (L-X-K)}{\beta_1 \beta_3 L S}$$

$$\begin{aligned}
 A &= \frac{S(1+i_1) - H}{\mu} + \frac{\beta_1 L \{L(1+i_2 + \beta_1) - X - K\}}{Y} \\
 &+ \frac{\beta_2 \{S(1+i_3 + \beta_3) - Y - H\}}{\mu \beta_4} + \frac{\beta_2 L^2 (i_4 + \beta_2 + \beta_4)}{S - Y - H}
 \end{aligned}$$

รูปที่ พ-7(17) สมมุติให้จุด A ทรวดตัวหนึ่งหน่วย ทำให้จุด B, C และ D ทรวดตัว $\frac{Y}{\beta_3 S}$, $\frac{\beta_1}{\beta_3}$ และ $\frac{\beta_1 \beta_2 L}{\beta_3 X} = \frac{(S-Y-H)}{\beta_4 S}$ หน่วยตามลำดับ ได้ความสัมพันธ์ของแรงดัดกับน้ำหนัก ดังสมการ (พ.68)

$$\begin{aligned}
 m_Y &= \frac{W_u}{6A} [\beta_3 S^2 (L-X-K) (3-\beta_3-\beta_4) + \beta_1 X S (3Y+3H-\beta_1 S) \\
 &+ \frac{\beta_3}{\beta_4} (S-Y-H)^2 (3X+3K-\beta_2 L) + 3KY^2] \\
 &+ \frac{1}{2A} [2P_2 KY + P_1 \{2\beta_1 HS - (\beta_1 S - Y)^2\} + \frac{P_4 \beta_1 S}{X} \{2\beta_2 KL
 \end{aligned}$$

$$- (\beta_2 L - X)^2 \} + P_3 \{ 2\beta_3 HS - (\beta_3 S - Y)^2$$

$$- \frac{\beta_3}{\beta_4} (\beta_4 S - S + Y + H)^2 \}$$

(W.68)

$$\text{เมื่อ } \beta_4 = \frac{\beta_3 X (S - Y - H)}{\beta_1 \beta_2 L S}$$

$$A = \frac{\beta_1 S \{ S(1 + i_1 + \beta_1) - H - Y \}}{\mu X} + \frac{\beta_3 S^2 (i_3 + \beta_3 + \beta_4)}{\mu (L - X - K)}$$

$$+ \frac{\beta_3 \{ L(1 + i_4 + \beta_2) - X - K \}}{\beta_4} + L(1 + i_2) - K$$

ภาคผนวก ข

รายละเอียดโปรแกรมคอมพิวเตอร์

```

10 REM *****
20 REM *
30 REM *
40 REM *          ## YTAD ##
50 REM *
60 REM *   YIELD-LINE THEORY ANALYSIS/DESIGN PROGRAM
70 REM *
80 REM *
90 REM *****
100 REM
110 REM
120 REM          NOTATION          DEFINITION
130 REM          XXXXXX          XXXXXX
140 REM
150 REM TY          = SLAB TYPES
160 REM Y$          = STEEL TYPES
170 REM FY          = YIELD STRENGTH OF STEEL
180 REM DT          = TOP STEEL DIMETER
190 REM DB          = BOTTOM STEEL DIMETER
200 REM FC          = CYLINDER STRENGTH OF CONCRETE
210 REM DF          = DEAD LOAD FACTOR
220 REM LF          = LIVE LOAD FACTOR
230 REM L, L1      = SPAN LENGTH
240 REM S, S1      = SPAN WIDTH
250 REM O, O1      = OPENING LENGTH
260 REM H, H1      = OPENING WIDTH
270 REM W          = UNIFORM LOAD
280 REM P, P1, ..., P4 = DISTRIBUTED LINE LOADS
290 REM I ( )      = NEGATIVE/POSITIVE YIELD MOMENTS RATIO
300 REM U          = POSITIVE YIELD MOMENTS RATIO (My/Mx)
310 REM My         = POSITIVE DESIGN MOMENTS IN X-DIRECTION
320 REM T          = SLAB THICKNESS
330 REM R          = STEP SIZE FOR ITERATION
340 REM AS         = TEMPERATURE STEEL
350 REM AA         = STEEL AREAS
360 REM A ( )      = POSITIVE STEEL AREAS
370 REM B ( )      = NEGATIVE STEEL AREAS
380 REM D ( )      = STEEL AREAS/METER
390 REM Q, Q1, Q2, QP = POSITIVE YIELD MOMENTS IN X-DIRECTION
400 REM LX         = TOP STEEL LENGTH IN X-DIRECTION
410 REM LY         = TOP STEEL LENGTH IN Y-DIRECTION
420 REM FB         = BOND STRESS
430 REM LD         = BOND LENGTH
440 REM D          = EFFECTIVE DEPTH OF R.C. SECTION
450 REM PB         = 40 % BALANCE STEEL RATIO
460 REM
470 REM   ### READ DATA ###
480 D$ = CHR$(4)
490 HOME : VTAB 10: PRINT "   Please turn on Printer : "
500 PRINT D$;"PR#0": VTAB 24: PRINT TAB(7)"Press RETURN key to continue"; INPUT "
";X$: PRINT D$;"PR#1"

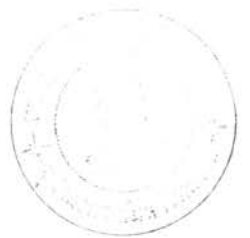
```

```

510 HOME
520 INPUT " SLAB TYPE ..... = ";TY
530 INPUT " STEEL TYPE. (RB= Round bar ;DB= Deform bar) . = ";Y$
540 INPUT " YIELD STRENGTH OF STEEL. (ksc.) ..... = ";FY
550 INPUT " TOP STEEL DIAMETER. (mm.) ..... = ";DT
560 IF TY = 3 THEN 580
570 INPUT " BOTTOM STEEL DIAMETER. (mm.) ..... = ";DB
580 INPUT " CYLINDER STRENGTH OF CONCRETE. (ksc.) . = ";FC
590 DF = 1.4;LF = 1.7
600 PRINT D$;"PR#0"
610 INPUT " Do you want to input LOAD FACTOR ? (Y/N) ";X$
620 PRINT D$;"PR#1"
630 IF X$ = "N" THEN 660
640 INPUT " DEAD LOAD FACTOR .. = ";DF
650 INPUT " LIVE LOAD FACTOR .. = ";LF: GOTO 680
660 PRINT " DEAD LOAD FACTOR .. = ";DF
670 PRINT " LIVE LOAD FACTOR .. = ";LF
680 INPUT " LENGTH OF SPAN Lx. (meter) ..... = ";L
690 INPUT " LENGTH OF SPAN Ly. (meter) ..... = ";S
700 J = 4: IF TY = 2 THEN J = 3
710 IF TY = 6 THEN J = 2
720 ON TY GOTO 840,850,880,890,900,920,930
730 FOR V = 1 TO J
740 PRINT " VALUE I(";V;") ..... =";: INPUT " ";I(V): NEXT V
750 INPUT " RATIO My/Mx. .... = ";U: RETURN
760 INPUT " UNIFORM LOAD. (kg/squar meter) .. = ";W: RETURN
770 INPUT " LENGTH OF OPENING, LO. (meter) .. = ";O
780 INPUT " WIDTH OF OPENING, WO. (meter) ... = ";H: RETURN
790 INPUT " LINE LOAD P1. (kg/meter) ..... = ";P1
800 INPUT " LINE LOAD P2. (kg/meter) ..... = ";P2: IF TY = 4 OR TY = 6 THEN RETURN

B10 IF TY = 3 THEN RETURN
B20 INPUT " LINE LOAD P3. (kg/meter) ..... = ";P3: IF TY = 5 THEN RETURN
B30 INPUT " LINE LOAD P4. (kg/meter) ..... = ";P4: RETURN
B40 GOSUB 760: GOSUB 730: GOTO 960
B50 GOSUB 760
B60 INPUT " LINE LOAD. P (kg/meter) ..... = ";P
B70 GOSUB 730: GOTO 960
B80 GOSUB 760: GOSUB 790: GOSUB 750: GOTO 960
B90 GOSUB 770: GOSUB 760: GOSUB 790: GOSUB 730: GOTO 960
900 INPUT " CENTER CO-ORDINATE OF OPENING FROM Y axi, X. (meter) = ";D
910 GOSUB 770: GOSUB 760: GOSUB 790: GOSUB 730: GOTO 960
920 GOSUB 770: GOSUB 760: GOSUB 790: GOSUB 730: GOTO 960
930 INPUT " CENTER CO-ORDINATE OF OPENING, (X,Y). (meter) = ";X,Y
940 GOSUB 770: GOSUB 760: GOSUB 790: GOSUB 730
950 REM ** MINIMUM SLAB THICKNESS **
960 T = INT (L * 25 / 7): IF TY = 2 THEN 1080
970 IF TY = 3 THEN 1070
980 CC = (L + S) * 2;DD = CC: IF TY = 6 THEN 1030
990 IF I(1) = 0 THEN CC = CC - S
1000 IF I(2) = 0 THEN CC = CC - L
1010 IF I(3) = 0 THEN CC = CC - S
1020 IF I(4) = 0 THEN CC = CC - L: GOTO 1050
1030 IF I(1) = 0 THEN CC = CC - 2 * S
1040 IF I(2) = 0 THEN CC = CC - 2 * L

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1050 EE = L / S; LL = L: IF S > L THEN EE = S / L; LL = S
1060 T = INT (100 * LL * (800 + .0017 * FY) / (36000 + 5000 * EE * (1 + CC / DD)) +
0.7): GOTO 1080
1070 IF S > L THEN T = INT (S * 25 / 7)
1080 PRINT D$;"PR#0": IF T < 9 THEN T = 9
1090 INPUT " Do you want to input SLAB THICKNESS ? (Y/N) ";X$
1100 PRINT D$;"PR#1"
1110 IF X$ = "N" THEN 1130
1120 INPUT " INITIAL SLAB THICKNESS . (cm.) .. = ";T: GOTO 1140
1130 PRINT " INITIAL SLAB THICKNESS . (cm.) .. = ";T
1140 IF TY = 1 THEN 1210
1150 PRINT D$;"PR#0":R = 0.05
1160 INPUT " Do you want to input STEP SIZE for iteration ? (Y/N) ";X$
1170 PRINT D$;"PR#1"
1180 IF X$ = "N" THEN 1200
1190 INPUT " STEP SIZE FOR ITERATION ..... = ";R: GOTO 1210
1200 PRINT " STEP SIZE FOR ITERATION ..... = ";R
1210 PRINT D$;"PR#0"
1220 INPUT " Do you accept these DATA ? (Y/N) ";X$
1230 PRINT D$;"PR#1"
1240 IF X$ = "N" THEN 510
1250 REM ## BOND LENGTH ##
1260 G$ = "ROUND BAR": IF Y$ = "DB" THEN G$ = "DEFORM BAR"
1270 IF Y$ = "RB" THEN FB = 22.55 * SQR (FC) / DT: GOTO 1300
1280 FB = 45.1 * SQR (FC) / DT: IF FB > 40 THEN FB = 40
1290 GOTO 1310
1300 IF FB > 11 THEN FB = 11
1310 LD = (DT * FY) / (40 * FB)
1320 K1 = 0.85
1330 IF FC > 280 AND FC < = 350 THEN K1 = 0.8
1340 IF FC > 350 AND FC < = 420 THEN K1 = 0.75
1350 IF FC > 420 THEN K1 = 0.7
1360 REM ## 40 % STEEL BALANCE ##
1370 PB = 2080 * K1 * FC / (FY * (6117 + FY))
1380 PRINT D$;"PR#0"
1390 HOME : VTAB 10: PRINT " Do you want to PLOT DATA ? (Y/N) ";: INPUT " ";X$: PRINT
D$;"PR#1"
1400 IF X$ = "N" THEN 1430
1410 PRINT D$;"BLOAD CHAIN,A520"
1420 CALL 520"PLOT DATA"
1430 PRINT D$;"PR#0": HOME : VTAB 8: INPUT " Do you want hard copy of MOMENT ? (Y/
N)";X$: PRINT D$;"PR#1"
1440 HOME :N = 0: IF TY = 6 OR TY = 7 THEN 1470
1450 PRINT D$;"BLOAD CHAIN,A520"
1460 CALL 520"PROGRAM 1"
1470 PRINT D$;"BLOAD CHAIN,A520"
1480 CALL 520"PROGRAM 2"

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1490 REM *****
1500 REM * *
1510 REM * ** PLOT DATA ** *
1520 REM * *
1530 REM *****
1540 REM
1550 DIM X(10),Y(10)
1560 PRINT D$;"PR#0"
1570 ON TY GOTO 1580,1580,1580,1620,1630,1580,1580
1580 X(2) = L:X(3) = X(2):Y(3) = S:Y(4) = S: IF TY < > 6 THEN 1600
1590 X(6) = (L - D) / 2:X(10) = X(6):X(9) = X(6):X(7) = (L + D) / 2:X(8) = X(7):Y(6) =
(S - H) / 2:Y(10) = Y(6):Y(7) = Y(6):Y(8) = (S + H) / 2:Y(9) = Y(8): GOTO 1680
1600 IF TY < > 7 THEN 1680
1610 X(6) = X - D / 2:X(10) = X(6):X(9) = X(6):X(7) = X + D / 2:X(8) = X(7):Y(6) = Y -
H / 2:Y(10) = Y(6):Y(7) = Y(6):Y(8) = Y + H / 2:Y(9) = Y(8): GOTO 1680
1620 X(2) = 0:X(3) = X(2):X(4) = L:X(5) = X(4):Y(1) = H:Y(2) = H:Y(7) = H:Y(5) = S:Y(
6) = S: GOTO 1680
1630 X(6) = D - D / 2:X(7) = X(6):X(4) = D + D / 2:X(5) = X(4):X(2) = L:X(3) = X(2)
1640 Y(5) = S - H:Y(6) = Y(5):Y(8) = S:Y(7) = S:Y(4) = S:Y(3) = S: GOTO 1680
1650 HOME : PRINT : PRINT : PRINT : PRINT TAB( 5)"-----": PRINT
1660 PRINT TAB( 5)"PLOT DATA": PRINT
1670 PRINT TAB( 5)"-----": PRINT : PRINT : PRINT : RETURN
1680 GOSUB 1650: IF N = 1 THEN 1730
1690 GOTO 1720
1700 PRINT D$;"PR#0"
1710 VTAB 24: PRINT TAB( 7)"Press RETURN key to continue";: INPUT " ";X$: PRINT D$;
"PR#1": RETURN
1720 GOSUB 1700: PRINT D$;"PR#0"
1730 TEXT : HOME
1740 HCOLOR= 7: HGR
1750 Q = 140 / L: IF S > L THEN Q = 140 / S
1760 J = 4: IF TY = 4 THEN J = 6
1770 IF TY = 5 THEN J = 8
1780 FOR V = 1 TO J
1790 X1 = X(V) * Q + 60:CC = X(V + 1) * Q + 60
1800 Y1 = Y(V) * Q + 10:DD = Y(V + 1) * Q + 10
1810 HPLLOT X1,Y1 TO CC,DD
1820 IF TY < > 6 AND TY < > 7 THEN 1860
1830 X1 = X(V + 5) * Q + 60:CC = X(V + 6) * Q + 60
1840 Y1 = Y(V + 5) * Q + 10:DD = Y(V + 6) * Q + 10
1850 HPLLOT X1,Y1 TO CC,DD
1860 NEXT V
1870 IF TY = 6 THEN I(3) = I(1):I(4) = I(2)
1880 FOR J = 1 TO 10
1890 X(J) = X(J) * Q + 60:Y(J) = Y(J) * Q + 10
1900 IF J > 2 AND TY = 4 THEN X(J - 2) = X(J):Y(J - 2) = Y(J)
1910 NEXT J
1920 IF TY = 5 THEN 2030
1930 J = 1: IF TY = 2 THEN J = 2:I(4) = I(2)
1940 IF TY = 3 THEN J = 3:I(1) = 1:I(4) = 1
1950 FOR V = J TO 4
1960 II(V) = I(V + 1): IF V > 3 THEN II(V) = I(1)

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1970 HH = ABS (X(V + 1) - X(V)) / 5: IF V = 2 OR V = 4 THEN HH = ABS (Y(V + 1) - Y(
    V)) / 5
1980 IF V = 1 THEN X1 = X(V):Y1 = Y(V): GOSUB 2100: GOTO 2020
1990 IF V = 2 THEN X1 = X(V):Y1 = Y(V): GOSUB 2140: GOTO 2020
2000 IF V = 3 THEN X1 = X(4):Y1 = Y(4) + 5: GOSUB 2100: GOTO 2020
2010 IF V = 4 THEN X1 = X(5) - 5:Y1 = Y(5): GOSUB 2140
2020 NEXT V: GOTO 2180
2030 FOR V = 1 TO 5
2040 IF V = 1 THEN HH = (X(2) - X(1)) / 5:II(V) = I(2):X1 = X(1):Y1 = Y(1): GOSUB 21
    00: GOTO 2090
2050 IF V = 2 THEN HH = (Y(3) - Y(2)) / 5:II(V) = I(3):X1 = X(2):Y1 = Y(2): GOSUB 21
    40: GOTO 2090
2060 IF V = 3 THEN HH = (X(3) - X(4)) / 5:II(V) = I(4):X1 = X(4):Y1 = Y(4) + 5: GOSUB
    2100: GOTO 2090
2070 IF V = 4 THEN HH = (X(7) - X(8)) / 5:II(V) = I(4):X1 = X(8):Y1 = Y(8) + 5: GOSUB
    2100: GOTO 2090
2080 IF V = 5 THEN HH = (Y(8) - Y(1)) / 5:II(V) = I(1):X1 = X(1) - 5:Y1 = Y(1): GOSUB
    2140
2090 NEXT V: GOTO 2180
2100 FOR SS = 1 TO HH
2110 HPLOT X1,Y1 TO X1 + 5,Y1 - 5: IF II(V) = 0 THEN 2130
2120 HPLOT X1,Y1 - 5 TO X1 + 5,Y1
2130 X1 = X1 + 5: NEXT SS: RETURN
2140 FOR SS = 1 TO HH
2150 HPLOT X1,Y1 TO X1 + 5,Y1 + 5: IF II(V) = 0 THEN 2170
2160 HPLOT X1 + 5,Y1 TO X1,Y1 + 5
2170 Y1 = Y1 + 5: NEXT SS: RETURN
2180 IF N = 1 THEN 2250
2190 GOSUB 1700: PRINT D$;"PR#0"
2200 TEXT : HOME : VTAB 10: INPUT " Do you want hard copy of this plot ? (Y/N) ";
    X$:N = 1
2210 IF X$ = "N" THEN 2260
2220 PRINT D$;"PR#1"
2230 FOR V = 1 TO 10
2240 X(V) = 0:Y(V) = 0: NEXT V: GOTO 1570
2250 PRINT CHR$(17): PRINT D$;"PR#0"
2260 TEXT : HOME : VTAB 8: INPUT " Do you want hard copy of moment ? (Y/N)";X$: PRINT
    D$;"PR#1"
2270 TEXT : HOME :N = 0: IF TY = 6 OR TY = 7 THEN 2300
2280 PRINT D$;"BLOAD CHAIN,A520"
2290 CALL 520"PROGRAM 1"
2300 PRINT D$;"BLOAD CHAIN,A520"
2310 CALL 520"PROGRAM 2"

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2320 REM *****
2330 REM *
2340 REM *          ## PROGRAM 1 ##
2350 REM *
2360 REM * ANALYSIS/DESIGN SLAB TYPES 1,2,3,4 AND 5
2370 REM *
2380 REM *****
2390 REM
2400 REM
2410 Z$ = "*****"
2420 ON TY GOTO 2540,3880,4750,5220,8360
2430 PRINT : PRINT : PRINT " XXXXXXXXXXXXXXXXXXXXXXXX"
2440 PRINT " % "
2450 PRINT " % MOMENT IN X-direction %"
2460 PRINT " % (kg-meter/meter) %"
2470 PRINT " % %"
2480 PRINT " XXXXXXXXXXXXXXXXXXXXXXXX": PRINT : RETURN
2490 REM
2500 REM *****
2510 REM ** DESIGN SLAB TYPE 1 **
2520 REM *****
2530 REM
2540 X = SQR (1 + I(1)) + SQR (1 + I(3)):Y = SQR (1 + I(2)) + SQR (1 + I(4))
2550 L1 = L:S1 = S:LX = L / 6:LY = S / 6:WU = LF * W + DF * 24 * T
2560 IF LX < LD / 100 THEN LX = LD / 100
2570 IF LY < LD / 100 THEN LY = LD / 100
2580 GOSUB 2430
2590 IF X$ = "Y" THEN 2610
2600 PRINT D$;"PR#0"
2610 Q = 0:N = N + 1: PRINT
2620 REM ## ANALYSIS SLAB TYPE 1 PATTERN 1 ##
2630 Q = (S ^ 4 / L ^ 2 * (SQR ((X / Y) ^ 2 + 3 * U * (L / S) ^ 2) - X / Y) ^ 2) / (
6 * U * Y ^ 2)
2640 PRINT " PATTERN 1 , My = ";Q * WU
2650 REM ## ANALYSIS SLAB TYPE 1 PATTERN 2 ##
2660 BB = (L ^ 4 / S ^ 2 * (SQR ((Y / X) ^ 2 + 3 * U * (S / L) ^ 2) - Y / X) ^ 2) / (
6 * U ^ 2 * X ^ 2)
2670 PRINT " PATTERN 2 , My = ";BB * WU
2680 PRINT D$;"PR#0"
2690 IF BB > Q THEN Q = BB
2700 REM ## COMPUTE LENGTH OF TOP STEEL ##
2710 IF N > 1 THEN 2730
2720 QP = Q:Q = 2 * Q
2730 IF QP > = Q THEN 2820
2740 IF I(1) + I(2) + I(3) + I(4) = 0 THEN 2820
2750 LX = LX + L1 / 24:LY = LY + S1 / 24
2760 IF I(1) > 0 THEN L = L1 - LX
2770 IF I(2) > 0 THEN S = S1 - LY
2780 IF I(3) > 0 THEN L = L - LX
2790 IF I(4) > 0 THEN S = S - LY
2800 IF L < T / 40 AND S < T / 40 THEN 2820
2810 X = 2:Y = 2: GOTO 2610

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2820 PRINT D$;"PR#1"
2830 PRINT : PRINT "MOMENT FOR DESIGN (My) = ";QP * WU
2840 WU = LF * W + DF * 24 * T:MY = WU * QP:NT = 0
2850 REM ## DESIGN TOP STEEL ##
2860 GOSUB 3570
2870 FOR J = 1 TO 4
2880 IF I(J) = 0 THEN 2940
2890 IF J = 1 OR J = 3 THEN M(J) = MY * I(J) / U: GOTO 2910
2900 M(J) = MY * I(J)
2910 D = T - 2
2920 GOSUB 3620: IF NT = 1 THEN 2840
2930 A(J) = AA
2940 NEXT J
2950 REM ## DESIGN BOTTOM STEEL ##
2960 FOR J = 1 TO 2
2970 IF J = 2 THEN M(J) = MY / U:D = T - 3: GOTO 2990
2980 M(J) = MY:D = T - 2
2990 GOSUB 3620: IF NT = 1 THEN 2840
3000 B(J) = AA: NEXT J
3010 GOSUB 3050
3020 END
3030 REM
3040 REM *** PRINT RESULTS SLAB TYPE 1,2,3,4,5 ***
3050 PRINT : PRINT Z$: PRINT
3060 PRINT TAB( 15);"% RESULT SLAB TYPE ";TY;" %X": PRINT : PRINT Z$
3070 PRINT TAB( 15);"- Lx SPAN = ";L1;" m."
3080 PRINT TAB( 15);"- Ly SPAN = ";S1;" m."
3090 PRINT TAB( 15);"- SLAB THICKNESS = ";T;" cm."
3100 PRINT TAB( 15);"- CYLINDER STRENGTH OF CONCRETE = ";FC;" ksc."
3110 PRINT TAB( 15);"- YIELD STRENGTH OF STEEL = ";FY;" ksc.": PRINT
3120 PRINT TAB( 15);"% TOP STEEL %"
3130 PRINT TAB( 15);"XXXXXXXXXXXXX": PRINT
3140 PRINT TAB( 5);"- ";G$;" DIMETER = ";DT;" mm."
3150 IF TY = 3 THEN 3210
3160 CC = 1.2 * DT: IF T - 2 > CC THEN CC = T - 2
3170 LX = INT (LX * 100 + CC):LY = INT (LY * 100 + CC)
3180 PRINT " SIDE(No.) AREA(cm^2/m) SPACING(cm) LENGTH FROM SUPPORT(cm)"
3190 PRINT " XXXXXXXXX XXXXXXXXX XXXXXXXXX XXXXXXXXXXXXXXXXXXXX"
3200 GOTO 3230
3210 PRINT " SIDE(No.) STEEL AREA(cm^2/m) SPACING(cm)"
3220 PRINT " XXXXXXXXX XXXXXXXXX XXXXXXXXX"
3230 JJ = 4: IF TY = 2 THEN JJ = 3
3240 IF TY = 3 THEN JJ = 2
3250 FOR J = 1 TO JJ
3260 IF TY = 3 THEN 3280
3270 CC = LX: IF J = 2 OR J = 4 THEN CC = LY
3280 D(J) = A(J) * 100
3290 IF A(J) = 0 THEN SL(J) = L1 * 100:CC = 0: GOTO 3320
3300 SL(J) = 11 * DT ^ 2 / 14 / A(J) / 100
3310 IF SL(J) > 3 * T THEN SL(J) = 3 * T
3320 IF TY < > 3 THEN 3340
3330 PRINT TAB( 3);J; TAB( 17);D(J); TAB( 36);SL(J): GOTO 3350
3340 PRINT TAB( 3);J; TAB( 14);D(J); TAB( 30);SL(J); TAB( 50);CC
3350 NEXT J
3360 PRINT : PRINT TAB( 15);"% BOTTOM STEEL %"

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3370 PRINT TAB( 15);"XXXXXXXXXXXXXXXXXX": PRINT
3380 PRINT TAB( 5);"- ";G$;" DIMETER = ";DB;" mm."
3390 PRINT " SPAN DIRECTION STEEL AREA(cm^2/m) SPACING(cm)"
3400 PRINT " XXXXXXXXXXXXXXXX XXXXXXXXXXXXXXXX XXXXXXXXXXXXXXXX"
3410 FOR J = 1 TO 2
3420 D(J) = B(J) * 100
3430 IF B(J) = 0 THEN SL(J) = L1 * 100: GOTO 3460
3440 SL(J) = 11 * DB ^ 2 / 14 / B(J) / 100
3450 IF SL(J) > 3 * T THEN SL(J) = 3 * T
3460 NEXT J
3470 PRINT TAB( 7);"Lx"; TAB( 23);D(2); TAB( 42);SL(2)
3480 PRINT TAB( 7);"Ly"; TAB( 23);D(1); TAB( 42);SL(1)
3490 ON TY GOTO 3550,3550,3550,3500,3500
3500 NT = (B(1) * D1 + B(2) * H1) * 100 / (D1 + H1) / 2
3510 NT = INT (NT / 11 / DB ^ 2 * 1400 + 0.5)
3520 PRINT : PRINT TAB( 11);"% STEEL AROUND OPENING %"
3530 PRINT TAB( 11);"XXXXXXXXXXXXXXXXXXXXXXXXXX": PRINT
3540 PRINT TAB( 5);"# ";NT;" ";G$;" DIMETER = ";DB;" mm."
3550 PRINT : PRINT Z$: RETURN
3560 REM %% COMPUTE TEMPERATURE STEEL %%
3570 IF G$ = "ROUND BAR" THEN AS = 0.0025 * T: GOTO 3600
3580 IF FY < 4200 THEN AS = 0.002 * T: GOTO 3600
3590 AS = 0.0018 * T
3600 RETURN
3610 REM %% COMPUTE TOP AND BOTTOM STEEL %%
3620 AA = AS
3630 M = 0.9 * AA * FY * (D - 0.59 * AA * FY / FC)
3640 IF M > = M(J) THEN 3690
3650 AA = AA + 0.001
3660 IF AA > PB * D THEN 3680
3670 GOTO 3630
3680 T = T + 1:NT = 1
3690 RETURN
3700 REM ## ANALYSIS SIMPLY SUPPORT SLAB TYPE 2 ##
3710 LL = WU * L * S / 6:SS = 2 * S / U / L:Q1 = 0:Q = 0:N = N + 1
3720 FOR V = 0.1 TO 0.5 STEP R
3730 XX = SS / V + 2 * V * L / S:BB = LL * (3 - 2 * V) / XX + P * L * (1 - V) / XX: IF
    BB > Q1 THEN Q1 = BB
3740 IF BB < Q1 THEN 3760
3750 NEXT V
3760 FOR V = 0.1 TO 1 STEP R
3770 XX = 2 * SS + L / V / S:BB = LL * (3 - V) / XX + P * L / 2 / XX: IF BB > Q THEN
    Q = BB
3780 IF BB < Q THEN 3800
3790 NEXT V
3800 IF Q > Q1 THEN Q1 = Q
3810 PRINT " SIMPLY SUPPORT SLAB TYPE 2 , My = ";Q1
3820 RETURN
3830 REM
3840 REM *****
3850 REM ** DESIGN SLAB TYPE 2 **
3860 REM *****
3870 REM
3880 WU = LF * W + DF * 24 * T:P = LF * P
3890 L1 = L:S1 = S:LX = L / 6:LY = S / 3
3900 IF LX < LD / 100 THEN LX = LD / 100

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3910 IF LY < LD / 100 THEN LY = LD / 100
3920 GOSUB 2430
3930 IF X$ = "Y" THEN 3950
3940 PRINT D$;"PR#0"
3950 N = 1: PRINT
3960 REM ## ANALYSIS SLAB TYPE 2 PATTERN 1 ##
3970 IF S > 3 * L THEN 4180
3980 LL = (1 + I(1)) * S / U / L:SS = (1 + I(3)) * S / U / L:HH = WU * L * S / 6:DD =
    P * L / 2:V = 0.4:V2 = V
3990 FOR E = 0.1 TO 1 - V STEP R
4000 GOSUB 4150: IF BB > Q THEN Q = BB:E1 = E
4010 IF BB < Q THEN 4030
4020 NEXT E
4030 IF Q > Q1 THEN Q1 = Q
4040 E = E1:Q = 0
4050 FOR V = 1 - E TO 0.1 STEP - R
4060 GOSUB 4150: IF BB > Q THEN Q = BB:V1 = V
4070 IF BB < Q THEN 4090
4080 NEXT V
4090 IF Q > Q1 THEN Q1 = Q
4100 V = V1:Q = 0:NC = NC + 1
4110 IF NC = 5 THEN 4130
4120 IF V < > V2 THEN V2 = V: GOTO 3990
4130 PRINT " PATTERN 1 , My = ";Q1
4140 NC = 0: GOTO 4180
4150 VV = V + E:X = LL / V + SS / E + L * (I(2) + VV) / S
4160 BB = HH * (3 - VV) / X + DD * (2 - VV) / X: RETURN
4170 REM ## ANALYSIS SLAB TYPE 2 PATTERN 2 ##
4180 V = 0.7:V2 = V:CC = (1 + I(2)) * L / S
4190 FOR E = 0.2 TO 0.8 STEP R
4200 GOSUB 4370: IF BB > Q THEN Q = BB:E1 = E
4210 IF BB < Q THEN 4230
4220 NEXT E
4230 IF Q > Q2 THEN Q2 = Q
4240 E = E1:Q = 0
4250 FOR V = 1 TO 0.1 STEP - R
4260 GOSUB 4370: IF BB > Q THEN Q = BB:V1 = V
4270 IF BB < Q THEN 4290
4280 NEXT V
4290 IF Q > Q2 THEN Q2 = Q
4300 V = V1:Q = 0:NC = NC + 1
4310 IF NC = 5 THEN 4330
4320 IF V < > V2 THEN V2 = V: GOTO 4190
4330 IF Q2 > Q1 THEN Q1 = Q2
4340 PRINT " PATTERN 2 , My = ";Q2
4350 PRINT D$;"PR#0"
4360 Q2 = 0:NC = 0: GOTO 4400
4370 X = LL / E + SS / (1 - E) + CC / V
4380 BB = HH * (3 - V) / X + DD / X: RETURN
4390 REM ## COMPUTE LENGTH OF TOP STEEL ##
4400 PRINT : IF N > 1 THEN 4420
4410 QP = Q1:Q1 = 2 * Q1
4420 IF QP > = Q1 THEN 4500
4430 IF I(1) + I(2) + I(3) = 0 THEN 4500
4440 LX = LX + L1 / 24:LY = LY + S1 / 12
4450 IF I(1) > 0 THEN L = L1 - LX

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4460 IF I(2) > 0 THEN S = S1 - LY
4470 IF I(3) > 0 THEN L = L - LX
4480 IF L < = 0 OR S < = 0 THEN 4500
4490 GOSUB 3710: GOTO 4400
4500 PRINT D$;"PR#1"
4510 PRINT : PRINT "MOMENT FOR DESIGN (My) = ";QP
4520 REM ## DESIGN TOP STEEL ##
4530 GOSUB 3570:NT = 0
4540 FOR J = 1 TO 3
4550 IF I(J) = 0 THEN 4610
4560 IF J = 2 THEN M(J) = QP * I(J): GOTO 4580
4570 M(J) = QP * I(J) / U
4580 D = T - 2
4590 GOSUB 3620: IF NT = 1 THEN 4530
4600 A(J) = AA
4610 NEXT J
4620 REM ## DESIGN BOTTOM STEEL ##
4630 FOR J = 1 TO 2
4640 IF J = 2 THEN M(J) = QP / U:D = T - 3: GOTO 4660
4650 M(J) = QP:D = T - 2
4660 GOSUB 3620: IF NT = 1 THEN 4530
4670 B(J) = AA: NEXT J
4680 GOSUB 3050
4690 END
4700 REM
4710 REM *****
4720 REM ** DESIGN SLAB TYPE 3 **
4730 REM *****
4740 REM
4750 WU = LF * W + DF * 24 * T:P1 = LF * P1:P2 = LF * P2
4760 GOSUB 2430
4770 IF X$ = "Y" THEN 4790
4780 PRINT D$;"PR#0"
4790 Q = 0
4800 REM ## ANALYSIS SLAB TYPE 3 PATTERN 1 ##
4810 FOR V = 0.2 TO 1.0 STEP R
4820 X = S / U / V / L + L / S
4830 BB = WU * L * S * (3 - V) / 6 / X + (P1 * L * (2 - V) + P2 * S) / 2 / X
4840 IF BB > Q THEN Q = BB
4850 IF BB < Q THEN 4870
4860 NEXT V
4870 PRINT " PATTERN 1 , My = ";Q
4880 Q1 = Q:Q = 0
4890 REM ## ANALYSIS SLAB TYPE 3 PATTERN 2 ##
4900 FOR V = 0.2 TO 0.99 STEP R
4910 X = S / U / L + L / V / S
4920 BB = WU * L * S * (3 - V) / 6 / X + (P1 * L + P2 * S * (2 - V)) / 2 / X
4930 IF BB > Q THEN Q = BB
4940 IF BB < Q THEN 4960
4950 NEXT V
4960 PRINT " PATTERN 2 , My = ";Q
4970 IF Q1 > Q THEN Q = Q1
4980 REM ## ANALYSIS SLAB TYPE 3 PATTERN 3 ##
4990 X = U * L * S / 2 / (U * L ^ 2 + S ^ 2)
5000 BB = X * (WU * L * S / 3 + P1 * L + P2 * S)
5010 IF BB > Q THEN Q = BB

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5020 PRINT " PATTERN 3 , My = ";BB
5030 PRINT D$;"PR#1"
5040 PRINT : PRINT "MOMENT FOR DESIGN (My) = ";Q
5050 REM ## DESIGN TOP STEEL ##
5060 GOSUB 3570:NT = 0
5070 FOR J = 1 TO 2
5080 IF J = 2 THEN M(J) = Q:D = T - 2: GOTO 5100
5090 M(J) = Q / U:D = T - 3
5100 GOSUB 3620: IF NT = 1 THEN 5060
5110 A(J) = AA: NEXT J
5120 L1 = L:S1 = S
5130 REM
5140 REM *** PRINT RESULTS SLAB TYPE 3 ***
5150 GOSUB 3050
5160 END
5170 REM
5180 REM *****
5190 REM ** DESIGN SLAB TYPE 4 **
5200 REM *****
5210 REM
5220 WU = LF * W + DF * 24 * T:P1 = LF * P1:P2 = LF * P2
5230 L1 = L:S1 = S:O1 = 0:H1 = H:L2 = L - 0:S2 = S - H:L3 = L2:S3 = S2:LX = L / 6:LY =
    S / 6:U1 = U
5240 IF LX < LD / 100 THEN LX = LD / 100
5250 IF LY < LD / 100 THEN LY = LD / 100
5260 GOSUB 2430
5270 IF X$ = "Y" THEN 5290
5280 PRINT D$;"PR#0"
5290 Q = 0:N = N + 1:Q1 = 0
5300 REM ## ANALYSIS SLAB TYPE 4 PATTERN 1 ##
5310 V = 0 / 2 / L:E = (L - 0) / 3 / L:V2 = V:E2 = E
5320 LL = L - 0:SS = S - H:HH = (1 + I(1)) * SS ^ 2 / U / L:DD = (1 + I(3)) * S ^ 2 /
    U / L
5330 FOR F = SS / S TO 0.99 STEP R
5340 GOSUB 5550: IF BB > Q THEN Q = BB:F1 = F
5350 IF BB < Q THEN 5370
5360 NEXT F
5370 IF Q > Q1 THEN Q1 = Q
5380 F = F1:Q = 0
5390 FOR E = LL / L TO 0.1 * LL / L STEP - R
5400 GOSUB 5550: IF BB > Q THEN Q = BB:E1 = E
5410 IF BB < Q THEN 5430
5420 NEXT E
5430 IF Q > Q1 THEN Q1 = Q
5440 E = E1:Q = 0
5450 FOR V = 0 / L TO 0.1 * 0 / L STEP - R
5460 GOSUB 5550: IF BB > Q THEN Q = BB:V1 = V
5470 IF BB < Q THEN 5490
5480 NEXT V
5490 IF Q > Q1 THEN Q1 = Q
5500 V = V1:Q = 0:NC = NC + 1
5510 IF NC = 5 THEN 5530
5520 IF V1 < > V2 OR E1 < > E2 THEN V2 = V1:E2 = E1: GOTO 5330
5530 PRINT " PATTERN 1 , My = ";Q1
5540 NC = 0: GOTO 5590

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5550 X = HH / V + L * (V + I(4)) + LL * (1 + F * I(2)) / (1 - F) + DD * F / E
5560 BB = WU * (SS ^ 2 * (3 * D - V * L) + F * S ^ 2 * (3 * LL - E * L)) / 6 / X
5570 BB = BB + (P1 * SS * (2 * D - V * L) + P2 * (S ^ 2 * F * (1 - F) + (F * S) ^ 2 -
      SS ^ 2)) / 2 / X: RETURN
5580 REM  ## ANALYSIS SLAB TYPE 4 PATTERN 2 ##
5590 V = H / 2 / S: E = (S - H) / 3 / S: V2 = V: E2 = E
5600 HH = U * (1 + I(2)) * LL ^ 2 / S: DD = (1 + I(4)) * U * L ^ 2 / S
5610 FOR F = LL / L TO 0.99 STEP R
5620 GOSUB 5840: IF BB > Q THEN Q = BB: F1 = F
5630 IF BB < Q THEN 5650
5640 NEXT F
5650 IF Q > Q2 THEN Q2 = Q
5660 F = F1: Q = 0
5670 FOR E = SS / S TO 0.1 * SS / S STEP - R
5680 GOSUB 5840: IF BB > Q THEN Q = BB: E1 = E
5690 IF BB < Q THEN 5710
5700 NEXT E
5710 IF Q > Q2 THEN Q2 = Q
5720 E = E1: Q = 0
5730 FOR V = H / S TO 0.1 * H / S STEP - R
5740 GOSUB 5840: IF BB > Q THEN Q = BB: V1 = V
5750 IF BB < Q THEN 5770
5760 NEXT V
5770 IF Q > Q2 THEN Q2 = Q
5780 V = V1: Q = 0: NC = NC + 1
5790 IF NC = 5 THEN 5810
5800 IF V1 < > V2 OR E1 < > E2 THEN V2 = V1: E2 = E1: GOTO 5610
5810 IF Q2 > Q1 THEN Q1 = Q2
5820 PRINT " PATTERN 2 , My = "; Q2
5830 Q2 = 0: NC = 0: GOTO 5880
5840 X = HH / V + SS * (1 + F * I(1)) / (1 - F) + S * (V + I(3)) + DD * F / E
5850 BB = WU * U * (LL ^ 2 * (3 * H - V * S) + F * L ^ 2 * (3 * SS - E * S)) / 6 / X
5860 BB = BB + U * (P1 * (F * L ^ 2 * (1 - F) + (F * L) ^ 2 - LL ^ 2) + P2 * LL * (2 *
      H - V * S)) / 2 / X: RETURN
5870 REM  ## ANALYSIS SLAB TYPE 4 PATTERN 3 ##
5880 F = H / 2 / S: V = 0 / 2 / L: F2 = F: V2 = V
5890 HH = L ^ 2: DD = (1 + I(2)) * LL ^ 2 / S
5900 FOR E = LL / L TO 1 - V STEP R
5910 GOSUB 6130: IF BB > Q THEN Q = BB: E1 = E
5920 IF BB < Q THEN 5940
5930 NEXT E
5940 IF Q > Q2 THEN Q2 = Q
5950 E = E1: Q = 0
5960 FOR V = 1 - E TO 0.1 * D / L STEP - R
5970 GOSUB 6130: IF BB > Q THEN Q = BB: V1 = V
5980 IF BB < Q THEN 6000
5990 NEXT V
6000 IF Q > Q2 THEN Q2 = Q
6010 V = V1: Q = 0
6020 FOR F = H / S TO 0.1 * H / S STEP - R
6030 GOSUB 6130: IF BB > Q THEN Q = BB: F1 = F
6040 IF BB < Q THEN 6060
6050 NEXT F
6060 IF Q > Q2 THEN Q2 = Q
6070 F = F1: Q = 0: NC = NC + 1

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6080 IF NC = 5 THEN 6100
6090 IF V1 < > V2 OR F1 < > F2 THEN V2 = V1:F2 = F1: GOTO 5900
6100 IF Q2 > Q1 THEN Q1 = Q2
6110 PRINT " PATTERN 3 , My = ";Q2
6120 Q2 = 0:NC = 0: GOTO 6170
6130 X = SS * (V + E + E * I(1)) / U / V + E * HH * (V + E + I(4)) / SS + S * (F + I(
3)) / U + DD / F
6140 BB = WU * (E * HH * SS * (3 - V - E) + LL ^ 2 * (3 * H - F * S)) / 6 / X
6150 BB = BB + (P1 * (2 * E * L * D - V * E * HH - (E * L - LL) ^ 2) + P2 * LL * (2 *
H - F * S)) / 2 / X: RETURN
6160 REM ** ANALYSIS SLAB TYPE 4 PATTERN 4 **
6170 V = 0 / 2 / L:F = H / 2 / S:V2 = V:F2 = F
6180 HH = S ^ 2:DD = (1 + I(2)) * LL:CC = (1 + I(1)) * SS ^ 2 / U / L
6190 FOR E = SS / S TO 1 - F STEP R
6200 GOSUB 6420: IF BB > Q THEN Q = BB:E1 = E
6210 IF BB < Q THEN 6230
6220 NEXT E
6230 IF Q > Q2 THEN Q2 = Q
6240 E = E1:Q = 0
6250 FOR F = 1 - E TO 0.1 * H / S STEP - R
6260 GOSUB 6420: IF BB > Q THEN Q = BB:F1 = F
6270 IF BB < Q THEN 6290
6280 NEXT F
6290 IF Q > Q2 THEN Q2 = Q
6300 F = F1:Q = 0
6310 FOR V = 0 / L TO 0.1 * D / L STEP - R
6320 GOSUB 6420: IF BB > Q THEN Q = BB:V1 = V
6330 IF BB < Q THEN 6350
6340 NEXT V
6350 IF Q > Q2 THEN Q2 = Q
6360 V = V1:Q = 0:NC = NC + 1
6370 IF NC = 5 THEN 6390
6380 IF V1 < > V2 OR F1 < > F2 THEN V2 = V1:F2 = F1: GOTO 6190
6390 IF Q2 > Q1 THEN Q1 = Q2
6400 PRINT " PATTERN 4 , My = ";Q2
6410 Q2 = 0:NC = 0: GOTO 6460
6420 X = CC / V + L * (V + 1 + I(4)) - D + E * HH * (E + F + I(3)) / U / LL + DD * E /
F
6430 BB = WU * (SS ^ 2 * (3 * D - V * L) + E * HH * LL * (3 - E - F)) / 6 / X
6440 BB = BB + (P1 * SS * (2 * D - V * L) + P2 * (2 * E * S * H - E * F * HH - (E * S
- SS) ^ 2)) / 2 / X: RETURN
6450 REM ** ANALYSIS SLAB TYPE 4 PATTERN 5 **
6460 V = 0 / 2 / L:F = (S - H) * 2 / 3 / S:V2 = V:F2 = F
6470 LL = (1 + I(1)) * SS * H / U / L:HH = (1 + I(3)) * S ^ 2 / U / L:DD = (1 + I(4))
* L:CC = S * L
6480 TT = 1 - 0.7 * H / V / S: IF V * (1 - F) * S / H > 0.7 THEN F = TT:F2 = F
6490 DD = 1 - V * (1 - F) * S / H: IF DD > (L - D) / L THEN DD = (L - D) / L
6500 FOR E = DD TO 0.1 * (L - D) / L STEP - R
6510 GOSUB 6750: IF BB > Q THEN Q = BB:E1 = E
6520 IF BB < Q THEN 6540
6530 NEXT E
6540 IF Q > Q2 THEN Q2 = Q
6550 E = E1:Q = 0
6560 FOR F = SS / S TO 0.1 * SS / S STEP - R
6570 IF V * (1 - F) * S / H > 1 - E THEN 6610

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6580 GOSUB 6750: IF BB > Q THEN Q = BB:F1 = F
6590 IF BB < Q THEN 6610
6600 NEXT F
6610 IF Q > Q2 THEN Q2 = Q
6620 F = F1:Q = 0
6630 FOR V = 0.1 * Q / L TO Q / L STEP R
6640 IF V * (1 - F) * S / H > 1 - E THEN 6680
6650 GOSUB 6750: IF BB > Q THEN Q = BB:V1 = V
6660 IF BB < Q THEN 6680
6670 NEXT V
6680 IF Q > Q2 THEN Q2 = Q
6690 V = V1:Q = 0:NC = NC + 1
6700 IF NC = 5 THEN 6720
6710 IF V1 < > V2 OR F1 < > F2 THEN V2 = V1:F2 = F1: GOTO 6490
6720 IF Q2 > Q1 THEN Q1 = Q2
6730 PRINT " PATTERN 5 , My = ";Q2
6740 Q2 = 0:NC = 0: GOTO 6800
6750 FF = 1 - F
6760 X = LL / V + DD * FF / F + HH * FF / E + L * (1 - V + I(2)) - D * I(2)
6770 BB = WU * S * FF * (3 * V * L * H - CC * E + 3 * CC * (1 + V * F - V) - FF * V *
    F * CC * S / H - (V * L * (SS - F * S) ^ 3 + 3 * D * H ^ 3) / H / S / FF) / 6 / X

6780 BB = BB + (P1 * H * (2 * D - V * L) + P2 * H ^ 2) / 2 / X: RETURN
6790 REM ## ANALYSIS SLAB TYPE 4 PATTERN 6 ##
6800 V = H / 2 / S:F = (L - D) * 2 / 3 / L:V2 = V:F2 = F
6810 LL = L - D:SS = (1 + I(2)) * LL * D * U / S:HH = (1 + I(3)) * S:DD = (1 + I(4)) *
    L ^ 2 * U / S:EE = S + I(1) * (S - H)
6820 TT = 1 - 0.7 * D / V / L: IF V * (1 - F) * L / D > 0.7 THEN F = TT:F2 = F
6830 DD = 1 - V * (1 - F) * L / D: IF DD > (S - H) / S THEN DD = (S - H) / S
6840 FOR E = DD TO 0.1 * (S - H) / S STEP - R
6850 GOSUB 7090: IF BB > Q THEN Q = BB:E1 = E
6860 IF BB < Q THEN 6880
6870 NEXT E
6880 IF Q > Q2 THEN Q2 = Q
6890 E = E1:Q = 0
6900 FOR F = LL / L TO 0.1 * LL / L STEP - R
6910 IF V * (1 - F) * L / D > 1 - E THEN 6950
6920 GOSUB 7090: IF BB > Q THEN Q = BB:F1 = F
6930 IF BB < Q THEN 6950
6940 NEXT F
6950 IF Q > Q2 THEN Q2 = Q
6960 F = F1:Q = 0
6970 FOR V = 0.1 * H / S TO H / S STEP R
6980 IF V * (1 - F) * L / D > 1 - E THEN 7020
6990 GOSUB 7090: IF BB > Q THEN Q = BB:V1 = V
7000 IF BB < Q THEN 7020
7010 NEXT V
7020 IF Q > Q2 THEN Q2 = Q
7030 V = V1:Q = 0:NC = NC + 1
7040 IF NC = 5 THEN 7060
7050 IF V1 < > V2 OR F1 < > F2 THEN V2 = V1:F2 = F1: GOTO 6830
7060 IF Q2 > Q1 THEN Q1 = Q2
7070 PRINT " PATTERN 6 , My = ";Q2
7080 Q2 = 0:NC = 0: GOTO 7130
7090 FF = 1 - F:X = SS / V + HH * FF / F + DD * FF / E + EE - S * V

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7100 BB = WU * L * U * FF * (3 * V * S * D - E * CC + 3 * CC * (1 + V * F - V) - (V *
      S * (LL - F * L) ^ 3 + 3 * H * D ^ 3) / D / L / FF - FF * V * F * CC * L / D) / 6
      / X
7110 BB = BB + U * (P1 * D ^ 2 + P2 * D * (2 * H - V * S)) / 2 / X: RETURN
7120 REM  * ANALYSIS SLAB TYPE 4 PATTERN 7 **
7130 V = 0.3 * S / L: E = H / S: V2 = V: E2 = E: IF L - D < S / 2 OR S - H < 0.7 * D THEN
      7450
7140 LL = (1 + I(2)) * (L - D) / S: SS = (1 + I(3)) * S / U / L: HH = (1 + I(4)) * L /
      S: DD = I(1) * (S - H) / U / L: EE = P1 * D + 2 * P2 * H
7150 LS = D * S * (1 - E) / L / (S - H): IF LS < D / L THEN LS = D / L
7160 RS = 1 - V: IF LS < E * D * S / H / L THEN LS = E * D * S / H / L
7170 FOR F = LS TO RS STEP R
7180 GOSUB 7420: IF BB > Q THEN Q = BB: F1 = F
7190 IF BB < Q THEN 7210
7200 NEXT F
7210 IF Q > Q2 THEN Q2 = Q
7220 F = F1: Q = 0
7230 LS = 1 - F * L * (S - H) / D / S: IF LS < 0.2 THEN LS = 0.2
7240 RS = F * L * H / D / S: IF RS > 0.8 THEN RS = 0.8
7250 FOR E = LS TO RS STEP R
7260 GOSUB 7420: IF BB > Q THEN Q = BB: E1 = E
7270 IF BB < Q THEN 7290
7280 NEXT E
7290 IF Q > Q2 THEN Q2 = Q
7300 E = E1: Q = 0
7310 FOR V = S / 5 / L TO 1 - F STEP R
7320 GOSUB 7420: IF BB > Q THEN Q = BB: V1 = V
7330 IF BB < Q THEN 7350
7340 NEXT V
7350 IF Q > Q2 THEN Q2 = Q
7360 V = V1: Q = 0: NC = NC + 1
7370 IF NC = 5 THEN 7390
7380 IF V2 < V OR E2 < E THEN V2 = V: E2 = E: GOTO 7150
7390 IF Q2 > Q1 THEN Q1 = Q2
7400 PRINT " PATTERN 7 , My = "; Q2
7410 Q2 = 0: NC = 0: GOTO 7450
7420 J = E * D / F / L: X = LL / E + SS / V + HH / (1 - E) + DD / F + S * (1 - J) / U /
      F / L
7430 BB = WU * (L * S * (3 - V - F) + J * D * (J * S - 3 * H) / E) / 6 / X + (EE - P2
      * J * S) * J / 2 / E / X: RETURN
7440 REM  ** ANALYSIS SLAB TYPE 4 PATTERN 8 **
7450 V = 0.3 * L / S: E = D / L: V2 = V: E2 = E: IF S - H < L / 2 OR L - D < 0.7 * H THEN
      7730
7460 LL = (1 + I(1)) * (S - H) / U / L: SS = (1 + I(4)) * L / S: HH = (1 + I(3)) * S /
      U / L: DD = I(2) * (L - D) / S: EE = P2 * H + 2 * P1 * D
7470 LS = H * L * (1 - E) / S / (L - D): IF LS < H / S THEN LS = H / S
7480 RS = 1 - V: IF LS < E * H * L / D / S THEN LS = E * H * L / D / S
7490 FOR F = LS TO RS STEP R
7500 GOSUB 7760: IF BB > Q THEN Q = BB: F1 = F
7510 IF BB < Q THEN 7530
7520 NEXT F
7530 IF Q > Q2 THEN Q2 = Q
7540 F = F1: Q = 0
7550 LS = 1 - F * S * (L - D) / H / L: IF LS < 0.2 THEN LS = 0.2
7560 RS = F * S * D / H / L: IF RS > 0.8 THEN RS = 0.8

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7570 FOR E = LS TO RS STEP R
7580 GOSUB 7760: IF BB > Q THEN Q = BB:E1 = E
7590 IF BB < Q THEN 7610
7600 NEXT E
7610 IF Q > Q2 THEN Q2 = Q
7620 E = E1:Q = 0
7630 FOR V = L / 5 / S TO 1 - F STEP R
7640 GOSUB 7760: IF BB > Q THEN Q = BB:V1 = V
7650 IF BB < Q THEN 7670
7660 NEXT V
7670 IF Q > Q2 THEN Q2 = Q
7680 V = V1:Q = 0:NC = NC + 1
7690 IF NC = 5 THEN 7710
7700 IF V2 < > V OR E2 < > E THEN V2 = V:E2 = E: GOTO 7470
7710 IF Q2 > Q1 THEN Q1 = Q2
7720 PRINT " PATTERN B , My = ";Q2
7730 PRINT D$;"PR#0"
7740 Q2 = 0:NC = 0: IF NE = 1 THEN RETURN
7750 GOTO 7790
7760 J = E * H / F / S:X = LL / E + SS / V + HH / (1 - E) + OO / F + L * (1 - J) / F /
S
7770 BB = WU * (L * S * (3 - V - F) + J * H * (J * L - 3 * O) / E) / 6 / X + (EE - P1
* J * L) * J / 2 / E / X: RETURN
7780 REM ## COMPUTE LENGTH OF TOP STEEL ##
7790 PRINT :U = U1: IF N > 1 THEN 7830
7800 QP = Q1:Q1 = 2 * Q1
7810 FOR J = 1 TO 4
7820 II(J) = I(J):I(J) = 0: NEXT J
7830 IF QP > = Q1 THEN 8030
7840 IF II(1) + II(2) + II(3) + II(4) = 0 THEN 8030
7850 LX = LX + L1 / 24:LY = LY + S1 / 24
7860 IF II(1) > 0 THEN L = L1 - LX:O = O1 - LX
7870 IF II(2) > 0 THEN S = S1 - LY:H = H1 - LY
7880 IF II(3) > 0 THEN L = L - LX:L3 = L2 - LX
7890 IF II(4) > 0 THEN S = S - LY:S3 = S2 - LY
7900 IF L3 < = 0 AND S3 < = 0 THEN 8030
7910 IF L < = 0 OR S < = 0 THEN 8030
7920 IF O < = 0 OR H < = 0 THEN 7980
7930 IF L3 < = 0 THEN P = P1:S = S3: GOSUB 3710: GOTO 7790
7940 IF S3 < = 0 THEN P = P2:L = S:S = L3:U = 1 / U1: GOSUB 3710: GOTO 7790
7950 IF L < T / 100 + O OR S < T / 100 + H THEN 8030
7960 GOTO 5290
7970 REM ## CLOSE FORM MOMENT FOR SIMPLY SUPPORT SLAB TYPE 1 ##
7980 Q1 = (S ^ 4 / L ^ 2 / 24 / U * ( SQR (1 + 3 * U * (L / S) ^ 2) - 1) ^ 2) * WU
7990 BB = (L ^ 4 / S ^ 2 / 24 / U ^ 2 * ( SQR (1 + 3 * U * (S / L) ^ 2) - 1) ^ 2) * W
U
8000 IF Q1 < BB THEN Q1 = BB
8010 PRINT " SIMPLY SUPPORT SLAB TYPE 1 , My = ";Q1
8020 N = N + 1: GOTO 7790
8030 PRINT D$;"PR#1"
8040 PRINT : PRINT "MOMENT FOR DESIGN (My) = ";QP
8050 REM ## DESIGN TOP STEEL ##
8060 GOSUB 3570:NT = 0
8070 FOR J = 1 TO 4
8080 IF II(J) = 0 THEN 8140

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8090 IF J = 1 OR J = 3 THEN M(J) = QP * II(J) / U: GOTO 8110
8100 M(J) = QP * II(J)
8110 D = T - 2
8120 GOSUB 3620: IF NT = 1 THEN 8060
8130 A(J) = AA
8140 NEXT J
8150 REM ## DESIGN BOTTOM STEEL ##
8160 FOR J = 1 TO 2
8170 IF J = 2 THEN M(J) = QP / U: D = T - 3: GOTO 8190
8180 M(J) = QP: D = T - 2
8190 GOSUB 3620: IF NT = 1 THEN 8060
8200 B(J) = AA: NEXT J
8210 REM
8220 REM *** PRINT RESULTS SLAB TYPE 4,5 ***
8230 PRINT : PRINT Z$: PRINT
8240 PRINT TAB( 15); "% RESULT SLAB TYPE "; TY; "%": PRINT : PRINT Z$
8250 PRINT TAB( 15); "- Lx SPAN = "; L1; " m."
8260 PRINT TAB( 15); "- Ly SPAN = "; S1; " m."
8270 PRINT TAB( 15); "- OPENING LENGTH (LD) = "; O1; " m."
8280 PRINT TAB( 15); "- OPENING WIDTH (WD) = "; H1; " m."
8290 GOSUB 3090
8300 END
8310 REM
8320 REM *****
8330 REM ** DESIGN SLAB TYPE 5 **
8340 REM *****
8350 REM
8360 WU = LF * W + DF * 24 * T: P1 = LF * P1: P2 = LF * P2: P3 = LF * P3
8370 REM ## CHANGE CO-ORDINATE OF OPENING CENTER AND DATA ##
8380 IF D > L / 2 THEN CC = I(1): I(1) = I(3): I(3) = CC: CC = P1: P1 = P3: P3 = CC: D2 =
      D: D = L - D
8390 D = D - D / 2
8400 LX = L / 6: LY = S / 6: L1 = L: S1 = S: O1 = 0: H1 = H: D1 = D: L2 = L - D - 0: S2 = S -
      H: P4 = P1: P5 = P2: P6 = P3: L3 = L2: S3 = S2: U1 = U
8410 IF LX < LD / 100 THEN LX = LD / 100
8420 IF LY < LD / 100 THEN LY = LD / 100
8430 GOSUB 2430
8440 IF X$ = "Y" THEN 8460
8450 PRINT D$; "PR#0"
8460 N = N + 1: O1 = 0: Q = 0
8470 REM ## ANALYSIS SLAB TYPE 5 PATTERN 1 ##
8480 LL = S * (1 + I(1)) / U / L: SS = S * (1 + I(3)) / U / L: OO = (1 + I(2)) * L / S:
      HH = (L + I(4)) * (L - O) / S: CC = (H * (P1 + P3) / 2 + O * P2) * H / S: DD = 0 *
      H ^ 2 / 2 / S
8490 V = ((S - H) * 0.4 + H) / S: V2 = V: NN = 0
8500 EE = V * S * D / H / L: IF EE > 0.8 THEN EE = 0.8
8510 IF NN = 1 THEN 8530
8520 E = EE / 2: E2 = E
8530 FF = V * S * (L - D - O) / H / L: IF FF > 1 - E THEN FF = 1 - E
8540 FOR F = FF TO 0.1 STEP - R
8550 GOSUB 8770: IF BB > Q THEN Q = BB: F1 = F
8560 IF BB < Q THEN 8580
8570 NEXT F
8580 IF Q > Q1 THEN Q1 = Q
8590 F = F1: Q = 0

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8600 IF EE > 1 - F THEN EE = 1 - F
8610 FOR E = EE TO 0.1 STEP - R
8620 GOSUB 8770: IF BB > Q THEN Q = BB:E1 = E
8630 IF BB < Q THEN 8650
8640 NEXT E
8650 IF Q > Q1 THEN Q1 = Q
8660 E = E1:Q = 0
8670 FOR V = H / S TO 0.9 STEP R
8680 GOSUB 8770: IF BB > Q THEN Q = BB:V1 = V
8690 IF BB < Q THEN 8710
8700 NEXT V
8710 IF Q > Q1 THEN Q1 = Q
8720 V = V1:Q = 0:NC = NC + 1
8730 IF NC = 5 THEN 8750
8740 IF V1 < > V2 OR E1 < > E2 THEN V2 = V1:E2 = E1:NN = 1: GOTO 8500
8750 PRINT " PATTERN 1 , My = ";Q1
8760 NC = 0: GOTO 8800
8770 X = LL / E + SS / F + DD / (1 - V) + HH / V
8780 BB = WU * (L * S * (3 - E - F) / 6 - DD / V) / X + CC / V / X: RETURN
8790 REM ## ANALYSIS SLAB TYPE 5 PATTERN 2 ##
8800 GG = H * L / S / (L - 0):F = (1 - GG) / 4 + GG:F2 = F
8810 IF GG > = 0.7 THEN 9110
8820 E = (1 - F) * 2 / 3:E2 = E
8830 EE = 1 - (L - D - 0) * F * S / H / L: IF EE < 0.1 THEN EE = 0.1
8840 FF = F * S * D / H / L: IF FF > 0.9 THEN FF = 0.9
8850 FOR V = EE TO FF STEP R
8860 GOSUB 9080: IF BB > Q THEN Q = BB:V1 = V
8870 IF BB < Q THEN 8890
8880 NEXT V
8890 IF Q > Q2 THEN Q2 = Q
8900 V = V1:Q = 0
8910 FOR F = GG TO 1 - E STEP R
8920 GOSUB 9080: IF BB > Q THEN Q = BB:F1 = F
8930 IF BB < Q THEN 8950
8940 NEXT F
8950 IF Q > Q2 THEN Q2 = Q
8960 F = F1:Q = 0
8970 FOR E = 1 - F TO 0.1 * (1 - GG) STEP - R
8980 GOSUB 9080: IF BB > Q THEN Q = BB:E1 = E
8990 IF BB < Q THEN 9010
9000 NEXT E
9010 IF Q > Q2 THEN Q2 = Q
9020 E = E1:Q = 0:NC = NC + 1
9030 IF NC = 5 THEN 9050
9040 IF E1 < > E2 OR F1 < > F2 THEN E2 = E1:F2 = F1: GOTO 8830
9050 IF Q2 > Q1 THEN Q1 = Q2
9060 PRINT " PATTERN 2 , My = ";Q2
9070 Q2 = 0:NC = 0: GOTO 9110
9080 X = LL / V + SS / (1 - V) + DD / E + HH / F
9090 BB = WU * (L * S * (3 - E - F) / 6 - DD / F) / X + CC / F / X: RETURN
9100 REM ## ANALYSIS SLAB TYPE 5 PATTERN 3 ##
9110 LL = L ^ 2 * (1 + I(2)) / S:SS = (1 + I(4)) / S:DD = 2 * (D * L + L * 0 - D * 0)
- 0 ^ 2:HH = L - D - 0:CC = S - H:DD = 3 * CC * L ^ 2
9120 V = (S - H) * 2 / 3 / S:F = H / S * 2 * D / L:J = H / S * 2 * HH / L:V2 = V:F2 =
F:J2 = J

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9130 FOR E = D / L TO (D + Q) / L STEP R
9140 GOSUB 9430: IF BB > Q THEN Q = BB:E1 = E
9150 IF BB < Q THEN 9170
9160 NEXT E
9170 IF Q > Q2 THEN Q2 = Q
9180 E = E1:Q = 0
9190 FOR V = CC / S TO 0.1 * CC / S STEP - R
9200 GOSUB 9430: IF BB > Q THEN Q = BB:V1 = V
9210 IF BB < Q THEN 9230
9220 NEXT V
9230 IF Q > Q2 THEN Q2 = Q
9240 V = V1:Q = 0
9250 FOR F = H / S TO 0.1 * H / S STEP - R
9260 GOSUB 9430: IF BB > Q THEN Q = BB:F1 = F
9270 IF BB < Q THEN 9290
9280 NEXT F
9290 IF Q > Q2 THEN Q2 = Q
9300 F = F1:Q = 0
9310 FOR J = H / S TO 0.1 * H / S STEP - R
9320 GOSUB 9430: IF BB > Q THEN Q = BB:J1 = J
9330 IF BB < Q THEN 9350
9340 NEXT J
9350 IF Q > Q2 THEN Q2 = Q
9360 J = J1:Q = 0:NC = NC + 1
9370 IF NC = 5 THEN 9400
9380 IF V1 < > V2 OR F1 < > F2 THEN V2 = V1:F2 = F1:J2 = J1: GOTO 9130
9390 IF J1 < > J2 THEN J2 = J1: GOTO 9130
9400 IF Q2 > Q1 THEN Q1 = Q2
9410 PRINT " PATTERN 3 , My = ";Q2
9420 Q2 = 0:NC = 0: GOTO 9470
9430 EE = 1 - E
9440 X = LL / V + CC / U / E / EE + S * (F + I(1)) / U / E + S * (J + I(3)) / U / EE +
SS * (D ^ 2 / E / F + HH ^ 2 / J / EE)
9450 BB = WU * (DD - V * S * L ^ 2 + D ^ 2 * (3 * H - F * S) / E + HH ^ 2 * (3 * H -
J * S) / EE) / 6 / X + (P2 * (DD / EE - (D ^ 2 + (E * L) ^ 2) / E / EE) + P1 * D *
(2 * H - F * S) / E + P3 * HH * (2 * H - J * S) / EE) / 2 / X: RETURN
9460 REM ## ANALYSIS SLAB TYPE 5 PATTERN 4 ##
9470 V = (D + Q / 3) / L:F = H / S * 2 * D / L:J = H / S * 2 * HH / L:V2 = V:F2 = F:J
2 = J
9480 FOR E = HH / L TO 1 - V STEP R
9490 GOSUB 9780: IF BB > Q THEN Q = BB:E1 = E
9500 IF BB < Q THEN 9520
9510 NEXT E
9520 IF Q > Q2 THEN Q2 = Q
9530 E = E1:Q = 0
9540 FOR V = D / L TO 1 - E STEP R
9550 GOSUB 9780: IF BB > Q THEN Q = BB:V1 = V
9560 IF BB < Q THEN 9580
9570 NEXT V
9580 IF Q > Q2 THEN Q2 = Q
9590 V = V1:Q = 0
9600 FOR F = H / S TO 0.1 * H / S STEP - R
9610 GOSUB 9780: IF BB > Q THEN Q = BB:F1 = F
9620 IF BB < Q THEN 9640
9630 NEXT F

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9640 IF Q > Q2 THEN Q2 = Q
9650 F = F1:Q = 0
9660 FOR J = H / S TO 0.1 * H / S STEP - R
9670 GOSUB 9780: IF BB > Q THEN Q = BB:J1 = J
9680 IF BB < Q THEN 9700
9690 NEXT J
9700 IF Q > Q2 THEN Q2 = Q
9710 J = J1:Q = 0:NC = NC + 1
9720 IF NC = 5 THEN 9750
9730 IF V1 < > V2 OR F1 < > F2 THEN V2 = V1:F2 = F1:J2 = J1: GOTO 9480
9740 IF J1 < > J2 THEN J2 = J1: GOTO 9480
9750 IF Q2 > Q1 THEN Q1 = Q2
9760 PRINT " PATTERN 4 , My = ";Q2
9770 Q2 = 0:NC = 0: GOTO 9830
9780 EE = V + E
9790 X = (EE + I(2)) * L ^ 2 / CC + CC * EE / V / E / U + S / U * ((F + I(1)) / V + (
  J + I(3)) / E) + SS * (D ^ 2 / V / F + HH ^ 2 / E / J)
9800 BB = WU * (L ^ 2 * CC * (3 - EE) + D ^ 2 * (3 * H - F * S) / V + HH ^ 2 * (3 * H
  - J * S) / E) / 6 / X + (P1 * D * (2 * H - F * S) / V + P3 * HH * (2 * H - J * S
  ) / E + P2 * (2 * L * D - (V * L - D) ^ 2 / V - (E * L - HH) ^ 2 / E)) / 2 / X
9810 RETURN
9820 REM ## ANALYSIS SLAB TYPE 5 PATTERN 5 ##
9830 LL = L * (1 + I(2)) - 0:OO = 3 * 0 * CC ^ 2 / S:DD = 2 * P2 * 0 * CC
9840 V = CC / S:F = H / S * 2 * D / L:J = H / S * 2 * HH / L:V2 = V:F2 = F:J2 = J
9850 FOR E = CC / S TO 1 - J STEP R
9860 GOSUB 10150: IF BB > Q THEN Q = BB:E1 = E
9870 IF BB < Q THEN 9890
9880 NEXT E
9890 IF Q > Q2 THEN Q2 = Q
9900 E = E1:Q = 0
9910 FOR J = 1 - E TO 0.1 * H / S STEP - R
9920 GOSUB 10150: IF BB > Q THEN Q = BB:J1 = J
9930 IF BB < Q THEN 9950
9940 NEXT J
9950 IF Q > Q2 THEN Q2 = Q
9960 J = J1:Q = 0
9970 FOR F = 1 - V TO 0.1 * H / S STEP - R
9980 GOSUB 10150: IF BB > Q THEN Q = BB:F1 = F
9990 IF BB < Q THEN 10010
10000 NEXT F
10010 IF Q > Q2 THEN Q2 = Q
10020 F = F1:Q = 0
10030 FOR V = CC / S TO 1 - F STEP R
10040 GOSUB 10150: IF BB > Q THEN Q = BB:V1 = V
10050 IF BB < Q THEN 10070
10060 NEXT V
10070 IF Q > Q2 THEN Q2 = Q
10080 V = V1:Q = 0:NC = NC + 1
10090 IF NC = 5 THEN 10120
10100 IF V1 < > V2 OR F1 < > F2 THEN V2 = V1:F2 = F1:J2 = J1: GOTO 9850
10110 IF J1 < > J2 THEN J2 = J1: GOTO 9850
10120 IF Q2 > Q1 THEN Q1 = Q2
10130 PRINT " PATTERN 5 , My = ";Q2
10140 Q2 = 0:NC = 0: GOTO 10190
10150 EE = E * S:FF = V * S

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10160 X = LL / FF + S * (V + F + I(1)) / U / D + EE * (E + J + I(3)) / U / V / HH + S
      S * (D / F + E * HH / V / J)
10170 BB = WU * (D * FF * (3 - V - F) + EE * HH * (3 - E - J) + DD) / 6 / V / X + (P1
      * (2 * H - (FF - CC) ^ 2 / FF - F * S) + DD / FF + P3 * (2 * H * E - (EE - CC) ^
      2 / S - J * EE) / V) / 2 / X: RETURN
10180 REM   ## ANALYSIS SLAB TYPE 5 PATTERN 6 ##
10190 LL = L - D - O:SS = S - H:DD = LL * (1 + I(4)):HH = S * (1 + I(1)) - H:CC = U *
      D ^ 2 * (1 + I(4))
10200 V = SS / S:F = H / S * 2 * LL / L:J = H / S * 2 * D / L:V2 = V:F2 = F:J2 = J
10210 FOR E = D / L TO (D + O) / L STEP R
10220 GOSUB 10510: IF BB > Q THEN Q = BB:E1 = E
10230 IF BB < Q THEN 10250
10240 NEXT E
10250 IF Q > Q2 THEN Q2 = Q
10260 E = E1:Q = 0
10270 FOR J = H / S TO 0.1 * H / S STEP - R
10280 GOSUB 10510: IF BB > Q THEN Q = BB:J1 = J
10290 IF BB < Q THEN 10310
10300 NEXT J
10310 IF Q > Q2 THEN Q2 = Q
10320 J = J1:Q = 0
10330 FOR F = 1 - V TO 0.1 * H / S STEP - R
10340 GOSUB 10510: IF BB > Q THEN Q = BB:F1 = F
10350 IF BB < Q THEN 10370
10360 NEXT F
10370 IF Q > Q2 THEN Q2 = Q
10380 F = F1:Q = 0
10390 FOR V = SS / S TO 1 - F STEP R
10400 GOSUB 10510: IF BB > Q THEN Q = BB:V1 = V
10410 IF BB < Q THEN 10430
10420 NEXT V
10430 IF Q > Q2 THEN Q2 = Q
10440 V = V1:Q = 0:NC = NC + 1
10450 IF NC = 5 THEN 10480
10460 IF V1 < > V2 OR F1 < > F2 THEN V2 = V1:F2 = F1:J2 = J1: GOTO 10210
10470 IF J1 < > J2 THEN J2 = J1: GOTO 10210
10480 IF Q2 > Q1 THEN Q1 = Q2
10490 PRINT " PATTERN 6 , My = ";Q2
10500 Q2 = 0:NC = 0: GOTO 10560
10510 EE = E * L:FF = J * S:GG = V * S
10520 X = SS * (FF + HH + CC / FF) / U / V / EE + S ^ 2 * (V + F + I(3)) / U / LL + (
      EE + I(2) * L + LL) / V + DD / F:X = 2 * V * X
10530 BB = WU * (GG * S * LL * (3 - V - F) / 3 + SS ^ 2 * (D + O - EE / 3) + D ^ 2 *
      SS * (H - FF / 3) / EE) / X + (P1 * D * SS * (2 * H - FF) / EE + P2 * SS * (2 * D
      - (EE - D) ^ 2 / EE) + P3 * (2 * H * GG - (GG - SS) ^ 2 - GG * F * S)) / X
10540 RETURN
10550 REM   ## ANALYSIS SLAB TYPE 5 PATTERN 7 ##
10560 DD = (1 + I(3)) * S ^ 2 / U / L / SS:HH = (1 + I(4)) * LL / SS:CC = (1 + I(4)) *
      D ^ 2 / L / S:DD = 2 * H * S - H ^ 2
10570 E = LL * 2 / 3 / L:F = H / S * 2 * D / L:J = H / S * 2 * LL / L:E2 = E:F2 = F:J
      2 = J
10580 FOR V = D / L TO (D + O) / L STEP R
10590 GOSUB 10880: IF BB > Q THEN Q = BB:V1 = V
10600 IF BB < Q THEN 10620
10610 NEXT V

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10620 IF Q > Q2 THEN Q2 = Q
10630 V = V1:Q = 0
10640 FOR E = LL / L TO 0.1 * LL / L STEP - R
10650 GOSUB 10880: IF BB > Q THEN Q = BB:E1 = E
10660 IF BB < Q THEN 10680
10670 NEXT E
10680 IF Q > Q2 THEN Q2 = Q
10690 E = E1:Q = 0
10700 FOR F = H / S TO 0.1 * H / S STEP - R
10710 GOSUB 10880: IF BB > Q THEN Q = BB:F1 = F
10720 IF BB < Q THEN 10740
10730 NEXT F
10740 IF Q > Q2 THEN Q2 = Q
10750 F = F1:Q = 0
10760 FOR J = H / S TO 0.1 * H / S STEP - R
10770 GOSUB 10880: IF BB > Q THEN Q = BB:J1 = J
10780 IF BB < Q THEN 10800
10790 NEXT J
10800 IF Q > Q2 THEN Q2 = Q
10810 J = J1:Q = 0:NC = NC + 1
10820 IF NC = 5 THEN 10850
10830 IF E1 < > E2 OR F1 < > F2 THEN E2 = E1:F2 = F1:J2 = J1: GOTO 10580
10840 IF J1 < > J2 THEN J2 = J1: GOTO 10580
10850 IF Q2 > Q1 THEN Q1 = Q2
10860 PRINT " PATTERN 7 , My = ";Q2
10870 Q2 = 0:NC = 0: GOTO 10930
10880 EE = V * L:FF = F * S:GG = 1 - J
10890 X = (EE + I(2) * L + LL) / SS + (SS + FF + I(1) * S) / U / EE + CC / V / F + HH
      * GG / J + DD * GG / E
10900 BB = WU * (SS * (3 * (D + D) - EE) + D ^ 2 * (3 * H - FF) / EE + S ^ 2 * GG * (
      3 * LL - E * L) / SS) / 6 / X + (P1 * D * (2 * H - FF) / EE + P2 * (2 * D - (EE -
      D) ^ 2 / EE) + P3 * (DD - J * S ^ 2) / SS) / 2 / X
10910 RETURN
10920 REM ## ANALYSIS SLAB TYPE 5 PATTERN 8 ##
10930 DD = L + L * I(2) - 0:HH = (1 + I(3)) / U / L:CC = 2 * P2 * 0 * SS:DD = 3 * 0 *
      SS ^ 2
10940 V = SS / S:J = H / S * 2 * LL / L:E = LL * 2 / 3 / L:V2 = V:J2 = J:E2 = E
10950 FOR F = 1 - V TO 0.1 * H / S STEP - R
10960 GOSUB 11250: IF BB > Q THEN Q = BB:F1 = F
10970 IF BB < Q THEN 10990
10980 NEXT F
10990 IF Q > Q2 THEN Q2 = Q
11000 F = F1:Q = 0
11010 FOR V = SS / S TO 1 - F STEP R
11020 GOSUB 11250: IF BB > Q THEN Q = BB:V1 = V
11030 IF BB < Q THEN 11050
11040 NEXT V
11050 IF Q > Q2 THEN Q2 = Q
11060 V = V1:Q = 0
11070 FOR J = H / S TO 0.1 * H / S STEP - R
11080 GOSUB 11250: IF BB > Q THEN Q = BB:J1 = J
11090 IF BB < Q THEN 11110
11100 NEXT J
11110 IF Q > Q2 THEN Q2 = Q
11120 J = J1:Q = 0
11130 FOR E = LL / L TO 0.1 * LL / L STEP - R

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11140 GOSUB 11250: IF BB > Q THEN Q = BB:E1 = E
11150 IF BB < Q THEN 11170
11160 NEXT E
11170 IF Q > Q2 THEN Q2 = Q
11180 E = E1:Q = 0:NC = NC + 1
11190 IF NC = 5 THEN 11220
11200 IF V1 < > V2 OR E1 < > E2 THEN V2 = V1:E2 = E1:J2 = J1: GOTO 10950
11210 IF J1 < > J2 THEN J2 = J1: GOTO 10950
11220 IF Q2 > Q1 THEN Q1 = Q2
11230 PRINT " PATTERN 8 , My = ";Q2
11240 Q2 = 0:NC = 0: GOTO 11290
11250 EE = V * S:FF = S ^ 2 * (1 - J)
11260 X = (EE * (EE + F * S) + I(1) * EE * S) / U / D + HH * FF / E + (1 + I(4)) * (V
    * D / F + LL * FF / J / S ^ 2) + DD
11270 BB = WU * (V * D * S ^ 2 * (3 - V - F) + FF * (3 * LL - E * L) + DD) / 6 / X +
    (P1 * EE * (2 * H - (EE - SS) ^ 2 / EE - F * S) + CC + P3 * (J * FF + (H - J * S)
    * (SS + FF / S))) / 2 / X: RETURN
11280 REM ## ANALYSIS SLAB TYPE 5 PATTERN 9 ##
11290 DD = (1 + I(3)) * S / U / L:DD = SS ^ 2 / S:HH = (1 + I(1)) / U / L
11300 V = 2 * D / 3 / L:E = 2 * LL / 3 / L:F = SS / S:V2 = V:E2 = E:F2 = F
11310 FOR J = SS / S TO 0.9 STEP R
11320 GOSUB 11610: IF BB > Q THEN Q = BB:J1 = J
11330 IF BB < Q THEN 11350
11340 NEXT J
11350 IF Q > Q2 THEN Q2 = Q
11360 J = J1:Q = 0
11370 FOR V = D / L TO 0.1 * D / L STEP - R
11380 GOSUB 11610: IF BB > Q THEN Q = BB:V1 = V
11390 IF BB < Q THEN 11410
11400 NEXT V
11410 IF Q > Q2 THEN Q2 = Q
11420 V = V1:Q = 0
11430 FOR E = LL / L TO 0.1 * LL / L STEP - R
11440 GOSUB 11610: IF BB > Q THEN Q = BB:E1 = E
11450 IF BB < Q THEN 11470
11460 NEXT E
11470 IF Q > Q2 THEN Q2 = Q
11480 E = E1:Q = 0
11490 FOR F = SS / S TO 0.9 STEP R
11500 GOSUB 11610: IF BB > Q THEN Q = BB:F1 = F
11510 IF BB < Q THEN 11530
11520 NEXT F
11530 IF Q > Q2 THEN Q2 = Q
11540 F = F1:Q = 0:NC = NC + 1
11550 IF NC = 5 THEN 11580
11560 IF E1 < > E2 OR V1 < > V2 THEN E2 = E1:V2 = V1:F2 = F1: GOTO 11310
11570 IF F1 < > F2 THEN F2 = F1: GOTO 11310
11580 IF Q2 > Q1 THEN Q1 = Q2
11590 PRINT " PATTERN 9 , My = ";Q2
11600 Q2 = 0:NC = 0: GOTO 11650
11610 EE = F * S:FF = J * S
11620 X = HH * EE / V + DD * J / E + I(2) * L / S + D * (1 + F * I(4)) / (S - EE) + L
    L * (1 + J * I(4)) / (S - FF):X = 2 * X
11630 BB = WU * (D * EE + LL * FF + O * DD - (V * EE + E * FF) * L / 3) / X + (P1 * (
    EE - DD) + CC / S + P3 * (FF - DD)) / X: RETURN

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11640 REM  ## ANALYSIS SLAB TYPE 5 PATTERN 10 ##
11650 HH = (1 + I(4)) * U * D ^ 2:CC = (1 + I(2)) * L:DD = H * D ^ 2
11660 J = H / S * 2 * D / L:V = (D + 0 / 2) / L:E = SS * 2 / 3 / S:J2 = J:V2 = V:E2 =
  E
11670 TT = 1 - (D + 0) * H / V / L / S: IF V * (1 - E) * S / H > = 0.8 THEN E = TT:E
  2 = E
11680 EE = V * (1 - E) * S / H: IF EE < (D + 0) / L THEN EE = (D + 0) / L
11690 FOR F = 1 - EE TO 0.1 * LL / L STEP - R
11700 GOSUB 12010: IF BB > Q THEN Q = BB:F1 = F
11710 IF BB < Q THEN 11730
11720 NEXT F
11730 IF Q > Q2 THEN Q2 = Q
11740 F = F1:Q = 0
11750 FOR J = H / S TO 0.1 * H / S STEP - R
11760 GOSUB 12010: IF BB > Q THEN Q = BB:J1 = J
11770 IF BB < Q THEN 11790
11780 NEXT J
11790 IF Q > Q2 THEN Q2 = Q
11800 J = J1:Q = 0
11810 FOR V = D / L TO (D + 0) / L STEP R
11820 IF V * (1 - E) * S / H > 1 - F THEN 11860
11830 GOSUB 12010: IF BB > Q THEN Q = BB:V1 = V
11840 IF BB < Q THEN 11860
11850 NEXT V
11860 IF Q > Q2 THEN Q2 = Q
11870 V = V1:Q = 0
11880 FOR E = SS / S TO 0.1 * SS / S STEP - R
11890 IF V * (1 - E) * S / H > 1 - F THEN 11930
11900 GOSUB 12010: IF BB > Q THEN Q = BB:E1 = E
11910 IF BB < Q THEN 11930
11920 NEXT E
11930 IF Q > Q2 THEN Q2 = Q
11940 E = E1:Q = 0:NC = NC + 1
11950 IF NC = 5 THEN 11980
11960 IF V1 < > V2 OR E1 < > E2 THEN V2 = V1:E2 = E1:J2 = J1: GOTO 11680
11970 IF J1 < > J2 THEN J2 = J1: GOTO 11680
11980 IF Q2 > Q1 THEN Q1 = Q2
11990 PRINT " PATTERN 10 , My = ";Q2
12000 Q2 = 0:NC = 0: GOTO 12060
12010 FF = V * L:GG = S * (1 - E):NN = J * S
12020 X = (NN + HH / NN + SS + S * I(1)) * H / U / FF + CC * GG / E / S + DD * GG / F
  + L - FF + I(4) * LL
12030 BB = WU * (L * S * E * GG * (3 - V * GG / H - F) + DD * (3 * H - NN) / FF + 2 *
  FF * (GG - H) ^ 2 * (GG + 2 * H) / H + L * GG ^ 2 * (3 * H - F * H - 3 * V * GG) /
  H - 3 * H ^ 2 * (D + 0 - FF) + 3 * FF * H * (GG - H) / 6 / X
12040 BB = BB + (P3 * H ^ 2 + P2 * H * (2 * 0 - (FF - D) ^ 2 / FF) + P1 * H * D * (2 *
  H - NN) / FF) / 2 / X: RETURN
12050 REM  ## ANALYSIS SLAB TYPE 5 PATTERN 11 ##
12060 IF S - H < L / 2 OR L - D - 0 < 0.7 * H THEN 12430
12070 LL = (1 + I(1)) * S / U / L:SS = (1 + I(3)) * S / U / L:HH = (1 + I(2)) * L / S
  :DD = (1 + I(4)) * D ^ 2 / L / S:CC = 2 * P1 * H * D:DD = 2 * P2 * 0 * L:GG = P3 *
  H * L:EE = I(4) * (L - D - 0) / S
12080 E = 0.3 * L / S:F = H / S:V = (D + 0) / L:E2 = E:F2 = F:V2 = V
12090 LS = H * L * (1 - V) / S / (L - D - 0): IF LS < H / S THEN LS = H / S
12100 IF LS < V * H * L / S / (D + 0) THEN LS = V * H * L / S / (D + 0)

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12110 RS = V * H * L / D / S: IF RS > 1 - E THEN RS = 1 - E
12120 FOR J = LS TO RS STEP R
12130 GOSUB 12450: IF BB > Q THEN Q = BB:J1 = J
12140 IF BB < Q THEN 12160
12150 NEXT J
12160 IF Q > Q2 THEN Q2 = Q
12170 J = J1:Q = 0
12180 FOR E = L / 5 / S TO 1 - J STEP R
12190 GOSUB 12450: IF BB > Q THEN Q = BB:E1 = E
12200 IF BB < Q THEN 12220
12210 NEXT E
12220 IF Q > Q2 THEN Q2 = Q
12230 E = E1:Q = 0
12240 FOR F = H / 5 / S TO H / S STEP R
12250 GOSUB 12450: IF BB > Q THEN Q = BB:F1 = F
12260 IF BB < Q THEN 12280
12270 NEXT F
12280 IF Q > Q2 THEN Q2 = Q
12290 F = F1:Q = 0
12300 LS = 1 - J * S * (L - D - D) / H / L: IF LS < J * S * D / H / L THEN LS = J * S
      * D / H / L
12310 RS = J * S * (D + D) / H / L: IF RS > 0.9 THEN RS = 0.9
12320 FOR V = LS TO RS STEP R
12330 GOSUB 12450: IF BB > Q THEN Q = BB:V1 = V
12340 IF BB < Q THEN 12360
12350 NEXT V
12360 IF Q > Q2 THEN Q2 = Q
12370 V = V1:Q = 0:NC = NC + 1
12380 IF NC = 5 THEN 12410
12390 IF E2 < > E OR F2 < > F THEN E2 = E:F2 = F:V2 = V: GOTO 12090
12400 IF V2 < > V THEN V2 = V: GOTO 12090
12410 IF Q2 > Q1 THEN Q1 = Q2
12420 PRINT " PATTERN 11 , My = ";Q2
12430 PRINT D$;"PR#0"
12440 Q2 = 0:NC = 0: GOTO 12480
12450 K = V * H / J / S:KK = K * L:FF = F * S:X = LL / V + SS / (1 - V) + HH / E + DD
      / V / F + EE / J + L * (1 - K) / J / S - (H - FF) / U / V / L
12460 BB = WU * (L * S * (3 - E - J) / 6 - D * H * K / 2 / V + (H - FF) * (KK - D) ^
      2 / 6 / V / L) / X + (CC - P1 * FF * D + DD * K - P2 * (KK - D) ^ 2 + 66 * K) / 2
      / V / L / X: RETURN
12470 REM ## COMPUTE LENGTH OF TOP STEEL ##
12480 P1 = P4:P2 = P5:P3 = P6:U = U1: PRINT
12490 IF N > 1 THEN 12530
12500 FOR J = 1 TO 4
12510 II(J) = I(J):I(J) = 0: NEXT J
12520 QP = Q1:Q1 = 2 * Q1
12530 IF QP > = Q1 THEN 12850
12540 IF II(1) + II(2) + II(3) + II(4) = 0 THEN 12850
12550 LX = LX + L1 / 24:LY = LY + S1 / 24
12560 IF II(1) > 0 THEN D = D1 - LX:L = L1 - LX
12570 IF II(2) > 0 THEN S3 = S2 - LY:S = S1 - LY
12580 IF II(3) > 0 THEN L3 = L2 - LX:L = L - LX
12590 IF II(4) > 0 THEN H = H1 - LY:S = S - LY
12600 IF L < = 0 OR S < = 0 THEN 12850
12610 IF D < = T / 100 AND L3 < = T / 100 THEN 12630
12620 GOTO 12640

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12630 IF S3 < = T / 100 THEN 12850
12640 IF II(1) > 0 AND LX > = D1 + Q1 THEN 12800
12650 IF II(3) > 0 AND LX > = L1 - D1 THEN 12800
12660 IF II(4) > 0 AND LY > = H1 THEN 12800
12670 IF S3 < = 0 THEN L = S:U = 1 / U1: GOTO 12690
12680 GOTO 12730
12690 IF D > = T / 100 THEN S = D:P = P1: GOSUB 3710:Q3 = Q1
12700 IF L3 > = T / 100 THEN S = L3:P = P3: GOSUB 3710
12710 IF Q3 > Q1 THEN Q1 = Q3
12720 Q3 = 0: GOTO 12480
12730 IF D < = 0 AND L3 < = 0 THEN L = L1 - 2 * LX:S = S3:P = P2: GOSUB 3710: GOTO
12480
12740 IF D < = 0 THEN D = D1 + D1 - LX:P1 = P2:P2 = P3:NE = 1: GOSUB 5290: GOTO 124
80
12750 IF L3 < = 0 THEN D = L1 - D1 - LX:P1 = P2:P2 = P1:NE = 1: GOSUB 5290: GOTO 12
480
12760 REM ## CHANGE CO-ORDINATE OF OPENING CENTER AND DATA ##
12770 IF D + D / 2 > L / 2 THEN CC = P1:P1 = P3:P3 = CC:D = L - D - D
12780 GOTO 8460
12790 REM ## CLOSE FORM MOMENT FOR SIMPLY SUPPORT SLAB TYPE 1 ##
12800 Q1 = (S ^ 4 / L ^ 2 / 24 / U * ( SQR (1 + 3 * U * (L / S) ^ 2) - 1) ^ 2) * WU
12810 BB = (L ^ 4 / S ^ 2 / 24 / U ^ 2 * ( SQR (1 + 3 * U * (S / L) ^ 2) - 1) ^ 2) *
WU
12820 IF BB > Q1 THEN Q1 = BB
12830 PRINT " SIMPLY SUPPORT SLAB TYPE 1 , My = ";Q1
12840 N = N + 1: GOTO 12480
12850 PRINT D;"PR#1"
12860 PRINT : PRINT "MOMENT FOR DESIGN (My) = ";QP
12870 REM ## DESIGN TOP STEEL ##
12880 GOSUB 3570:NT = 0
12890 FOR J = 1 TO 4
12900 IF II(J) = 0 THEN 12960
12910 IF J = 1 OR J = 3 THEN M(J) = QP * II(J) / U: GOTO 12930
12920 M(J) = QP * II(J)
12930 D = T - 2
12940 GOSUB 3620: IF NT = 1 THEN 12880
12950 A(J) = AA
12960 NEXT J
12970 REM ## DESIGN BOTTOM STEEL ##
12980 FOR J = 1 TO 2
12990 IF J = 2 THEN M(J) = QP / U:D = T - 3: GOTO 13010
13000 M(J) = QP:D = T - 2
13010 GOSUB 3620: IF NT = 1 THEN 12880
13020 B(J) = AA: NEXT J
13030 REM
13040 REM ** PRINT RESULTS SLAB TYPE 5 **
13050 IF D2 > L1 / 2 THEN CC = A(1):A(1) = A(3):A(3) = CC
13060 GOTO 8230

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13070 REM *****
13080 REM *
13090 REM *          ## PROGRAM 2 ##          *
13100 REM *
13110 REM *          ANALYSIS/DESIGN SLAB TYPES 6 AND 7          *
13120 REM *
13130 REM *****
13140 REM
13150 REM
13160 Z$ = "*****"
13170 YT = TY - 5
13180 DN YT GOTO 13950,14970
13190 PRINT : PRINT : PRINT "  XXXXXXXXXXXXXXXXXXXXXXXXXXXX"
13200 PRINT "  %              %"
13210 PRINT "  % MOMENT IN X-direction %"
13220 PRINT "  % (kg-meter/meter) %"
13230 PRINT "  %              %"
13240 PRINT "  XXXXXXXXXXXXXXXXXXXXXXXXXXXX": PRINT : RETURN
13250 REM
13260 REM *** PRINT RESULTS SLAB TYPE 6,7 ***
13270 PRINT TAB( 15);"- SLAB THICKNESS = ";T;" cm."
13280 PRINT TAB( 15);"- CYLINDER STRENGTH OF CONCRETE = ";FC;" ksc."
13290 PRINT TAB( 15);"- YIELD STRENGTH OF STEEL = ";FY;" ksc.": PRINT
13300 PRINT TAB( 15);"% TOP STEEL %"
13310 PRINT TAB( 15);"XXXXXXXXXXXXX": PRINT
13320 PRINT TAB( 5);"- ";G$;" DIMETER = ";DT;" mm."
13330 CC = 1.2 * DT: IF T - 2 > CC THEN CC = T - 2
13340 LX = INT (LX * 100 + CC):LY = INT (LY * 100 + CC)
13350 PRINT " SIDE(No.) AREA(cm^2/m) SPACING(cm) LENGTH FROM SUPPORT(cm)"
13360 PRINT " XXXXXXXXX XXXXXXXXXXXX XXXXXXXXXXXX XXXXXXXXXXXX"
13370 JJ = 4: IF TY = 6 THEN JJ = 2
13380 FOR J = 1 TO JJ
13390 CC = LX: IF J = 2 OR J = 4 THEN CC = LY
13400 D(J) = A(J) * 100
13410 IF A(J) = 0 THEN SL(J) = L1 * 100:CC = 0: GOTO 13440
13420 SL(J) = 11 * DT ^ 2 / 14 / A(J) / 100
13430 IF SL(J) > 3 * T THEN SL(J) = 3 * T
13440 PRINT TAB( 3);J; TAB( 14);D(J); TAB( 30);SL(J); TAB( 50);CC: NEXT J
13450 PRINT : PRINT TAB( 15);"% BOTTOM STEEL %"
13460 PRINT TAB( 15);"XXXXXXXXXXXXX": PRINT
13470 PRINT TAB( 5);"- ";G$;" DIMETER = ";DB;" mm."
13480 PRINT " SPAN DIRECTION STEEL AREA(cm^2/m) SPACING(cm)"
13490 PRINT " XXXXXXXXXXXX XXXXXXXXXXXX XXXXXXXXXXXX"
13500 FOR J = 1 TO 2
13510 D(J) = B(J) * 100
13520 SL(J) = 11 * DB ^ 2 / 14 / B(J) / 100
13530 IF SL(J) > 3 * T THEN SL(J) = 3 * T
13540 NEXT J
13550 PRINT TAB( 7);"Lx"; TAB( 23);D(2); TAB( 42);SL(2)
13560 PRINT TAB( 7);"Ly"; TAB( 23);D(1); TAB( 42);SL(1)
13570 NT = (B(1) * D1 + B(2) * H1) * 100 / (D1 + H1) / 2
13580 NT = INT (NT / 11 / DB ^ 2 * 1400 + 0.5)

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13590 PRINT : PRINT TAB( 11);"% STEEL AROUND OPENING %"
13600 PRINT TAB( 11);"XXXXXXXXXXXXXXXXXXXXXXXXX": PRINT
13610 PRINT TAB( 5);"# ";NT;" ";G$;" DIMETER = ";DB;" mm."
13620 PRINT : PRINT Z$: RETURN
13630 REM %% COMPUTE TEMPERATURE STEEL %%
13640 IF G$ = "ROUND BAR" THEN AS = 0.0025 * T: GOTO 13670
13650 IF FY < 4200 THEN AS = 0.002 * T: GOTO 13670
13660 AS = 0.0018 * T
13670 RETURN
13680 REM %% COMPUTE TOP AND BOTTOM STEEL %%
13690 AA = AS
13700 M = 0.9 * AA * FY * (D - 0.59 * AA * FY / FC)
13710 IF M > = M(J) THEN 13760
13720 AA = AA + 0.001
13730 IF AA > PB * D THEN 13750
13740 GOTO 13700
13750 T = T + 1:NT = 1
13760 RETURN
13770 REM ## ANALYSIS SIMPLY SUPPORT SLAB TYPE 2 ##
13780 LL = WU * L * S / 6:SS = 2 * S / U / L:Q1 = 0:Q = 0:N = N + 1
13790 FOR V = 0.1 TO 0.5 STEP R
13800 XX = SS / V + 2 * V * L / S:BB = LL * (3 - 2 * V) / XX + P * L * (1 - V) / XX: IF
    BB > Q1 THEN Q1 = BB
13810 IF BB < Q1 THEN 13830
13820 NEXT V
13830 FOR V = 0.1 TO 1 STEP R
13840 XX = 2 * SS + L / V / S:BB = LL * (3 - V) / XX + P * L / 2 / XX: IF BB > Q THEN
    Q = BB
13850 IF BB < Q THEN 13870
13860 NEXT V
13870 IF Q > Q1 THEN Q1 = Q
13880 PRINT " SIMPLY SUPPORT SLAB TYPE 2 , My = ";Q1
13890 RETURN
13900 REM
13910 REM *****
13920 REM ** DESIGN SLAB TYPE 6 **
13930 REM *****
13940 REM
13950 WU = LF * W + DF * 24 * T:P1 = LF * P1:P2 = LF * P2
13960 LX = L / 6:LY = S / 6:L1 = L:S1 = S:O1 = 0:H1 = H:L2 = (L - D) / 2:S2 = (S - H)
    / 2:L3 = L2:S3 = S2:U1 = U
13970 IF LX < LD / 100 THEN LX = LD / 100
13980 IF LY < LD / 100 THEN LY = LD / 100
13990 GOSUB 13190
14000 IF X$ = "Y" THEN 14020
14010 PRINT D$;"PR#0"
14020 Q = 0:N = N + 1:Q1 = 0
14030 REM ## ANALYSIS SLAB TYPE 6 PATTERN 1 ##
14040 LL = 2 * (1 + I(1)) * S ^ 2 / U / L:SS = 4 * ((1 + I(2)) * L - D):HH = 0 * H *
    (2 * S - H) / 2
14050 DD = L * S ^ 2 / 6:PP = 2 * P2 * 0 * (S - H) + P1 * H * (2 * S - H):EE = (L - D
    ) / 2 / L
14060 FOR V = 0.1 TO EE STEP R
14070 X = LL / V + SS
14080 BB = WU * (DD * (3 - 2 * V) - HH) / X + PP / X

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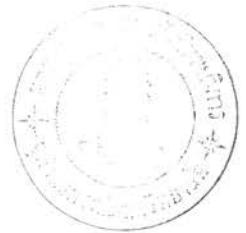
14090 IF BB > Q1 THEN Q1 = BB
14100 IF BB < Q1 THEN 14120
14110 NEXT V
14120 PRINT " PATTERN 1 , My = ";Q1
14130 REM ## ANALYSIS SLAB TYPE 6 PATTERN 2 ##
14140 LL = 2 * (1 + I(2)) * L ^ 2 / S;SS = 4 * ((1 + I(1)) * S - H) / U;HH = 0 * H *
      (2 * L - 0) / 2
14150 DD = L ^ 2 * S / 6;PP = 2 * P1 * H * (L - 0) + P2 * 0 * (2 * L - 0);EE = (S - H
      ) / 2 / S
14160 FOR V = 0.1 TO EE STEP R
14170 X = LL / V + SS
14180 BB = WU * (DD * (3 - 2 * V) - HH) / X + PP / X
14190 IF BB > Q THEN Q = BB
14200 IF BB < Q THEN 14220
14210 NEXT V
14220 PRINT " PATTERN 2 , My = ";Q
14230 IF Q > Q1 THEN Q1 = Q
14240 Q = 0
14250 REM ## ANALYSIS SLAB TYPE 6 PATTERN 3 ##
14260 LL = S ^ 2 * (L - 0);SS = 3 * 0 * (S - H) ^ 2;HH = 2 * P2 * 0 * (S - H)
14270 DD = 2 * S ^ 2 / U / (L - 0);PP = L * (1 + I(2)) - 0;CC = 4 * S * H
14280 FOR V = (S - H) / 2 / S TO 0.5 STEP R
14290 X = V * (2 * V + I(1)) * DD + PP
14300 BB = WU * (V * (6 - 4 * V) * LL + SS) / 24 / X + (HH + P1 * (CC * V - (2 * V *
      S - S + H) ^ 2)) / 4 / X
14310 IF BB > Q THEN Q = BB
14320 IF BB < Q THEN 14340
14330 NEXT V
14340 PRINT " PATTERN 3 , My = ";Q
14350 IF Q > Q1 THEN Q1 = Q
14360 Q = 0
14370 REM ## ANALYSIS SLAB TYPE 6 PATTERN 4 ##
14380 LL = L ^ 2 * (S - H);SS = 3 * H * (L - 0) ^ 2;HH = 2 * P1 * H * (L - 0)
14390 DD = 2 * L ^ 2 / (S - H);PP = (S * (1 + I(1)) - H) / U;CC = 4 * L * 0
14400 FOR V = (L - 0) / 2 / L TO 0.5 STEP R
14410 X = V * (2 * V + I(2)) * DD + PP
14420 BB = WU * (V * (6 - 4 * V) * LL + SS) / 24 / X + (HH + P2 * (CC * V - (2 * V *
      L - L + 0) ^ 2)) / 4 / X
14430 IF BB > Q THEN Q = BB
14440 IF BB < Q THEN 14460
14450 NEXT V
14460 PRINT " PATTERN 4 , My = ";Q
14470 PRINT D$;"PR#0"
14480 IF Q > Q1 THEN Q1 = Q
14490 REM ## COMPUTE LENGTH OF TOP STEEL ##
14500 U = U1: PRINT : IF N > 1 THEN 14540
14510 FOR J = 1 TO 2
14520 II(J) = I(J):I(J) = 0: NEXT J
14530 QP = Q1:Q1 = 2 * Q1
14540 IF QP > = Q1 THEN 14640
14550 IF II(1) + II(2) = 0 THEN 14640
14560 LX = LX + L1 / 24;LY = LY + S1 / 24
14570 IF II(1) > 0 THEN L = L1 - 2 * LX:L3 = L2 - LX
14580 IF II(2) > 0 THEN S = S1 - 2 * LY:S3 = S2 - LY
14590 IF L < T / 100 + Q1 AND S < T / 100 + H1 THEN 14640

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14600 IF L3 < = 0 THEN L = L1 - 2 * LX:S = S3:P = P2: GOSUB 13780
14610 IF S3 < = 0 THEN L = S1 - 2 * LY:S = L3:P = P1:U = 1 / U1: GOSUB 13780
14620 IF L3 < = 0 OR S3 < = 0 THEN 14500
14630 GOTO 14020
14640 PRINT D$;"PR#1"
14650 PRINT : PRINT "MOMENT FOR DESIGN (My) = ";QP
14660 REM ## DESIGN TOP STEEL ##
14670 GOSUB 13640:NT = 0
14680 FOR J = 1 TO 2
14690 IF II(J) = 0 THEN 14750
14700 IF J = 2 THEN M(J) = QP * II(J): GOTO 14720
14710 M(J) = QP * II(J) / U
14720 D = T - 2
14730 GOSUB 13690: IF NT = 1 THEN 14670
14740 A(J) = AA
14750 NEXT J
14760 REM ## DESIGN BOTTOM STEEL ##
14770 FOR J = 1 TO 2
14780 IF J = 2 THEN M(J) = QP / U:D = T - 3: GOTO 14800
14790 M(J) = QP:D = T - 2
14800 GOSUB 13690: IF NT = 1 THEN 14670
14810 B(J) = AA: NEXT J
14820 REM
14830 REM *** PRINT RESULTS SLAB TYPE 6 ***
14840 PRINT : PRINT Z$: PRINT
14850 PRINT TAB( 15);"ZX RESULT SLAB TYPE ";TY;" ZZ": PRINT : PRINT Z$
14860 PRINT TAB( 15);"- Lx SPAN = ";L1;" m."
14870 PRINT TAB( 15);"- Ly SPAN = ";S1;" m."
14880 PRINT TAB( 15);"- OPENING LENGTH (LO) = ";O1;" m."
14890 PRINT TAB( 15);"- OPENING WIDTH (WO) = ";H1;" m."
14900 GOSUB 13270
14910 END
14920 REM
14930 REM *****
14940 REM ** DESIGN SLAB TYPE 7 **
14950 REM *****
14960 REM
14970 X2 = X:Y2 = Y
14980 WU = LF * W + DF * 24 * T
14990 P1 = LF * P1:P2 = LF * P2:P3 = LF * P3:P4 = LF * P4
15000 GOSUB 15030
15010 GOTO 15150
15020 REM ## CHECK CO-ORDINATE OF OPENING CENTER ##
15030 IF X > L / 2 AND Y > S / 2 THEN 15080
15040 IF X > L / 2 THEN 15110
15050 IF Y > S / 2 THEN 15130
15060 RETURN
15070 REM ## CHANGE CO-ORDINATE OF OPENING CENTER AND DATA ##
15080 CC = I(1):I(1) = I(3):DD = I(2):I(2) = I(4):I(3) = CC:I(4) = DD
15090 CC = P1:P1 = P3:DD = P2:P2 = P4:P3 = CC:P4 = DD
15100 X = L - X:Y = S - Y: RETURN
15110 CC = I(1):I(1) = I(3):I(3) = CC:X = L - X
15120 CC = P1:P1 = P3:P3 = CC: RETURN
15130 CC = I(2):I(2) = I(4):I(4) = CC:Y = S - Y
15140 CC = P2:P2 = P4:P4 = CC: RETURN

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15150 X = X - D / 2; Y = Y - H / 2
15160 LX = L / 6; LY = S / 6; L1 = L; S1 = S; O1 = O; H1 = H; X1 = X; Y1 = Y; L2 = L - X - D;
      S2 = S - Y - H; P5 = P1; P6 = P2; P7 = P3; P8 = P4; S3 = S2; L3 = L2; U1 = U; G = 0.1
15170 IF LX < LD / 100 THEN LX = LD / 100
15180 IF LY < LD / 100 THEN LY = LD / 100
15190 GDSUB 13190
15200 IF X$ = "Y" THEN 15220
15210 PRINT D$; "PR#0"
15220 Q = 0; N = N + 1; Q1 = 0
15230 REM ## ANALYSIS SLAB TYPE 7 PATTERN 1 ##
15240 IF X < 0.2 * S THEN 15530
15250 HH = Y + H; O0 = (1 + I(1)) * S ^ 2 / U / L; LL = (1 + I(3)) * S ^ 2 / U / L; SS =
      (1 + I(2)) * L; YY = (1 + I(4)) * L
15260 V = 0.2 * S / L; E = 0.2 * S / L; V2 = V; E2 = E
15270 FOR F = HH / S TO Y / S STEP - R
15280 GDSUB 15490: IF BB > Q THEN Q = BB; F1 = F
15290 IF BB < Q THEN 15310
15300 NEXT F
15310 IF Q > Q1 THEN Q1 = Q
15320 F = F1; Q = 0
15330 FOR V = X / L TO 0.2 * S / L STEP - R
15340 GDSUB 15490: IF BB > Q THEN Q = BB; V1 = V
15350 IF BB < Q THEN 15370
15360 NEXT V
15370 IF Q > Q1 THEN Q1 = Q
15380 V = V1; Q = 0
15390 FOR E = (L - X - D) / L TO 0.2 * S / L STEP - R
15400 GDSUB 15490: IF BB > Q THEN Q = BB; E1 = E
15410 IF BB < Q THEN 15430
15420 NEXT E
15430 IF Q > Q1 THEN Q1 = Q
15440 E = E1; Q = 0; NC = NC + 1
15450 IF NC = 5 THEN 15470
15460 IF V2 < > V OR E2 < > E THEN V2 = V; E2 = E; GOTO 15270
15470 PRINT " PATTERN 1 , My = "; Q1
15480 NC = 0; GOTO 15530
15490 FF = 1 - F; EE = F * S; VV = (EE ^ 2 - Y ^ 2) / F + (HH - EE) * (2 * S - HH - EE)
      / FF
15500 XX = 2 * (O0 / V + LL / E + SS / F + YY / FF - O / F / FF)
15510 BB = WU * (L * S ^ 2 * (3 - E - V) / 3 - VV * O) / XX + ((P1 + P3) * VV + 2 * O
      * (P2 * Y / F + P4 * (S - HH) / FF)) / XX; RETURN
15520 REM ## ANALYSIS SLAB TYPE 7 PATTERN 2 ##
15530 IF Y + H > 0.6 * S OR X < 0.7 * (Y + H) THEN 15890
15540 HH = Y + H; O0 = 3 * D * H * (HH + Y) / S; LL = (1 + I(4)) * L / S; SS = (1 + I(3))
      * S / U / L; YY = (1 + I(1)) * S / U / L
15550 CC = (1 + I(2)) * L / S; DD = (H * (HH + Y) * (P1 + P3) + 2 * O * (P2 * Y + P4 *
      HH)) / 2 / S
15560 F = 0.6; V = 0.7 * F * S / L; F2 = F; V2 = V
15570 LS = 0.2 * S / L; IF LS > X / L THEN LS = X / L
15580 RS = F * S * (L - O - X) / L / HH; IF RS > 1 - V THEN RS = 1 - V
15590 FOR E = LS TO RS STEP R
15600 GDSUB 15860: IF BB > Q THEN Q = BB; E1 = E
15610 IF BB < Q THEN 15630
15620 NEXT E
15630 IF Q > Q2 THEN Q2 = Q

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15640 E = E1:Q = 0
15650 LS = 0.2 * S / L: IF LS > X / L THEN LS = X / L
15660 RS = F * X * S / L / HH: IF RS > 1 - E THEN RS = 1 - E
15670 FOR V = LS TO RS STEP R
15680 GOSUB 15860: IF BB > Q THEN Q = BB:V1 = V
15690 IF BB < Q THEN 15710
15700 NEXT V
15710 IF Q > Q2 THEN Q2 = Q
15720 V = V1:Q = 0
15730 LS = E * L * HH / S / (L - Q - X): IF LS < HH / S THEN LS = HH / S
15740 IF LS < V * L * HH / S / X THEN LS = V * L * HH / S / X
15750 FOR F = LS TO 0.8 STEP R
15760 GOSUB 15860: IF BB > Q THEN Q = BB:F1 = F
15770 IF BB < Q THEN 15790
15780 NEXT F
15790 IF Q > Q2 THEN Q2 = Q
15800 F = F1:Q = 0:NC = NC + 1
15810 IF NC = 5 THEN 15830
15820 IF F < > F2 OR V2 < > V THEN F2 = F:V2 = V: GOTO 15570
15830 IF Q2 > Q1 THEN Q1 = Q2
15840 PRINT " PATTERN 2 , My = ";Q2
15850 Q2 = 0:NC = 0: GOTO 15890
15860 XX = LL / (1 - F) + SS / E + YY / V + CC / F
15870 BB = WU * (L * S * (3 - V - E) - DD / F) / 6 / XX + DD / F / XX: RETURN
15880 REM ## ANALYSIS SLAB TYPE 7 PATTERN 3 ##
15890 IF (X + D) / (S - H) > 0.7 OR Y < 0.8 * (X + D) THEN 16230
15900 HH = 2 * X + D:DD = 3 * H * D * HH / L:LL = (1 + I(1)) * S / U / L:SS = (1 + I(
    2)) * L / S:YY = (1 + I(3)) * S / U / L
15910 CC = (1 + I(4)) * L / S:DD = (D * HH * (P2 + P4) + 2 * H * (P1 * X + P3 * (X +
    D))) / 2 / L:GG = X + D
15920 E = 0.2 * S / L:V = S * GG / L / (S - H) + R:E2 = E:V2 = V
15930 LS = 1 - V * L * (S - Y - H) / S / GG: IF LS < 0.2 THEN LS = 0.2
15940 RS = V * L * Y / S / GG: IF RS > 0.8 THEN RS = 0.8
15950 FOR F = LS TO RS STEP R
15960 GOSUB 16200: IF BB > Q THEN Q = BB:F1 = F
15970 IF BB < Q THEN 15990
15980 NEXT F
15990 IF Q > Q2 THEN Q2 = Q
16000 F = F1:Q = 0
16010 LS = (1 - F) * GG * S / L / (S - Y - H): IF LS < F * S * GG / L / Y THEN LS = F
    * S * GG / L / Y
16020 IF LS < S * GG / L / (S - H) THEN LS = S * GG / L / (S - H)
16030 FOR V = LS TO 1 - E STEP R
16040 GOSUB 16200: IF BB > Q THEN Q = BB:V1 = V
16050 IF BB < Q THEN 16070
16060 NEXT V
16070 IF Q > Q2 THEN Q2 = Q
16080 V = V1:Q = 0
16090 FOR E = 1 - V TO 0.2 * S / L STEP - R
16100 GOSUB 16200: IF BB > Q THEN Q = BB:E1 = E
16110 IF BB < Q THEN 16130
16120 NEXT E
16130 IF Q > Q2 THEN Q2 = Q
16140 E = E1:Q = 0:NC = NC + 1
16150 IF NC = 5 THEN 16170

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16160 IF E2 < > E OR V2 < > V THEN E2 = E:V2 = V: GOTO 15930
16170 IF Q2 > Q1 THEN Q1 = Q2
16180 PRINT " PATTERN 3 , My = ";Q2
16190 Q2 = 0:NC = 0: GOTO 16230
16200 XX = LL / V + SS / F + YY / E + CC / (1 - F)
16210 BB = WU * (L * S * (3 - V - E) - DD / V) / 6 / XX + DD / V / XX: RETURN
16220 REM ## ANALYSIS SLAB TYPE 7 PATTERN 4 ##
16230 HH = L - X - 0:DD = S - Y - H:LL = 3 * 0 * DD ^ 2:SS = 3 * 0 * Y ^ 2:YY = 2 * P
      2 * 0 * Y
16240 IF HH < 0.3 * S OR Y + H < 0.2 * S THEN 16570
16250 CC = 2 * P4 * 0 * DD:DD = (1 + I(3)) * S ^ 2 / U / L:GG = (1 + I(4)) * L - 0:ZZ
      = (1 + I(2)) * L - 0
16260 V = 0.3 * S / L:E = (Y + H / 2) / S:V2 = V:E2 = E
16270 LS = E * DD / S / (1 - E): IF LS < Y / S THEN LS = Y / S
16280 FOR F = LS TO E STEP R
16290 GOSUB 16520: IF BB > Q THEN Q = BB:F1 = F
16300 IF BB < Q THEN 16320
16310 NEXT F
16320 IF Q > Q2 THEN Q2 = Q
16330 F = F1:Q = 0
16340 FOR V = HH / L TO 0.2 * S / L STEP - R
16350 GOSUB 16520: IF BB > Q THEN Q = BB:V1 = V
16360 IF BB < Q THEN 16380
16370 NEXT V
16380 IF Q > Q2 THEN Q2 = Q
16390 V = V1:Q = 0
16400 RS = F / (DD / S + F): IF RS > (Y + H) / S THEN RS = (Y + H) / S
16410 FOR E = F TO RS STEP R
16420 GOSUB 16520: IF BB > Q THEN Q = BB:E1 = E
16430 IF BB < Q THEN 16450
16440 NEXT E
16450 IF Q > Q2 THEN Q2 = Q
16460 E = E1:Q = 0:NC = NC + 1
16470 IF NC = 5 THEN 16490
16480 IF V2 < > V OR E2 < > E THEN V2 = V:E2 = E: GOTO 16270
16490 IF Q2 > Q1 THEN Q1 = Q2
16500 PRINT " PATTERN 4 , My = ";Q2
16510 Q2 = 0:NC = 0: GOTO 16570
16520 J = F * (1 - E) / E:EE = E * S:FF = F * S ^ 2:VV = F / J
16530 XX = FF * (I(1) + F + J) / U / X + DD * E / V + GG * E / (1 - E) + ZZ
16540 BB = WU * (EE * S * (3 * HH - V * L) + X * FF * (3 - F - J) + LL * VV + SS) / 6
      / XX
16550 BB = BB + (P1 * F * (2 * H * S - (J * S - DD) ^ 2 / J) - P1 * (F * S - Y) ^ 2 +
      P3 * (EE ^ 2 - Y ^ 2 + (Y + H - EE) * (EE + VV * DD)) + YY + CC * VV) / 2 / XX: RETURN

16560 REM ## ANALYSIS SLAB TYPE 7 PATTERN 5 ##
16570 HH = X + 0:DD = S - Y - H:LL = 3 * H * Y * X ^ 2:SS = 2 * P1 * H * X:YY = 2 * 0
      * P4
16580 IF L - HH < 0.3 * S OR Y + H < 0.2 * S THEN 16930
16590 CC = 2 * 0 * Y * P2 - P3 * Y ^ 2:DD = (1 + I(3)) * S / U / L:GG = (S * (1 + I(1
      )) - H) * Y / U:ZZ = (1 + I(4)) * L:WW = (1 + I(2)) * L - HH
16600 V = 0.3 * S / L:J = X / L:V2 = V:J2 = J
16610 LS = X * Y / (X * Y + J * L * DD): IF LS < Y / S THEN LS = Y / S
16620 RS = Y * HH / (J * L * DD + Y * HH): IF RS > (Y + H) / S THEN RS = (Y + H) / S
16630 FOR E = LS TO RS STEP R
16640 GOSUB 16880: IF BB > Q THEN Q = BB:E1 = E

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16650 IF BB < Q THEN 16670
16660 NEXT E
16670 IF Q > Q2 THEN Q2 = Q
16680 E = E1:Q = 0
16690 FOR V = (L - HH) / L TO 0.3 * S / L STEP - R
16700 GOSUB 16880: IF BB > Q THEN Q = BB:V1 = V
16710 IF BB < Q THEN 16730
16720 NEXT V
16730 IF Q > Q2 THEN Q2 = Q
16740 V = V1:Q = 0
16750 LS = X * Y * (1 - E) / L / E / DD: IF LS < X / L THEN LS = X / L
16760 RS = Y * (1 - E) * HH / (L * E * DD): IF RS > HH / L THEN RS = HH / L
16770 FOR J = LS TO RS STEP R
16780 GOSUB 16880: IF BB > Q THEN Q = BB:J1 = J
16790 IF BB < Q THEN 16810
16800 NEXT J
16810 IF Q > Q2 THEN Q2 = Q
16820 J = J1:Q = 0:NC = NC + 1
16830 IF NC = 5 THEN 16850
16840 IF V2 < V OR J2 < J THEN V2 = V:J2 = J: GOTO 16610
16850 IF Q2 > Q1 THEN Q1 = Q2
16860 PRINT " PATTERN 5 , My = ";Q2
16870 Q2 = 0:NC = 0: GOTO 16930
16880 F = J * E * DD / Y / (1 - E):FF = F * Y / J:JJ = J * L:VV = F * L:EE = E * S
16890 XX = DD * EE / V + GG / JJ + (ZZ - HH + VV) * E / (1 - E) + JJ + WW
16900 BB = WU * (EE * S * (3 * (L - HH) - V * L) + Y ^ 2 * (3 * HH - JJ) + FF * DD *
      (3 * HH - VV) + LL / JJ) / 6 / XX
16910 BB = BB + (Y * (SS - P2 * (JJ - X) ^ 2 - P4 * (VV - X) ^ 2) / JJ + YY * FF + P3
      * ((Y + H) * (EE + FF) - EE * FF) + CC) / 2 / XX: RETURN
16920 REM ## ANALYSIS SLAB TYPE 7 PATTERN 6 ##
16930 HH = X + 0:DD = S - Y - H:LL = 3 * 0 * Y ^ 2:SS = 3 * L * DD * HH / X:YY = DD *
      L ^ 2 / X
16940 IF L - HH < 0.3 * S OR Y + H < 0.2 * S THEN 17280
16950 CC = Y * (2 * P2 * 0 - P3 * Y) / S:DD = 2 * P4 * 0 * L / X:GG = (1 + I(3)) * S /
      U / L:ZZ = L + I(2) * L - 0:WW = L - HH + I(4) * L:QQ = DD + I(1) * S
16960 V = 0.3 * S / L:E = (Y + H) / L:V2 = V:E2 = E
16970 LS = E * X * DD / S / (1 - E) / HH: IF LS < Y / S THEN LS = Y / S
16980 RS = E * DD / S / (1 - E): IF RS > (Y + H) / S THEN RS = (Y + H) / S
16990 FOR J = RS TO LS STEP - R
17000 GOSUB 17230: IF BB > Q THEN Q = BB:J1 = J
17010 IF BB < Q THEN 17030
17020 NEXT J
17030 IF Q > Q2 THEN Q2 = Q
17040 J = J1:Q = 0
17050 FOR V = (L - HH) / L TO 0.3 * S / L STEP - R
17060 GOSUB 17230: IF BB > Q THEN Q = BB:V1 = V
17070 IF BB < Q THEN 17090
17080 NEXT V
17090 IF Q > Q2 THEN Q2 = Q
17100 V = V1:Q = 0
17110 LS = J * S / (DD + J * S):RS = J * S * HH / (X * DD + J * S * HH): IF RS > (Y +
      H) / S THEN RS = (Y + H) / S
17120 FOR E = RS TO LS STEP - R
17130 GOSUB 17230: IF BB > Q THEN Q = BB:E1 = E
17140 IF BB < Q THEN 17160
17150 NEXT E

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17160 IF Q > Q2 THEN Q2 = Q
17170 E = E1:Q = 0:NC = NC + 1
17180 IF NC = 5 THEN 17200
17190 IF V2 < > V OR E2 < > E THEN V2 = V:E2 = E: GOTO 16970
17200 IF Q2 > Q1 THEN Q1 = Q2
17210 PRINT " PATTERN 6 , My = ";Q2
17220 Q2 = 0:NC = 0: GOTO 17280
17230 F = E * X * DD / J / L / S / (1 - E):EE = E * S:JJ = J * S:FF = F * L
17240 XX = GG / V + ZZ / EE + (WW + FF) / (S - EE) + (QQ + JJ) * J / U / E / X
17250 BB = WU * (S * (3 * (L - HH) - V * L) + LL / EE + J * X * (3 * (Y + H) - JJ) /
  E + J * F * (SS - YY * F) / E) / 6 / XX
17260 BB = BB + (CC + P1 * (2 * J * H - (JJ - Y) ^ 2 / S) + DD * J * F - P4 * J * (FF
  - X) ^ 2 / X + P3 * (EE * E + (H + Y - EE) * (E * X + J * FF) / X)) / 2 / E / XX
: RETURN
17270 REM ## ANALYSIS SLAB TYPE 7 PATTERN 7 ##
17280 HH = Y + H:DD = 3 * H * D * (HH + Y):LL = 2 * D * (P2 * Y + P4 * HH) + P3 * H *
  (HH + Y):SS = L * S ^ 2
17290 IF L - X - D < 0.2 * S OR HH < 0.5 * X THEN 17640
17300 CC = S ^ 2 * (1 + I(1)) / U / L:DD = (1 + I(3)) * S ^ 2 / U / L:GG = (1 + I(4))
  * L:ZZ = (1 + I(2)) * L + X:YY = S / U / L
17310 E = HH / S:F = X / L:E2 = E:F2 = F
17320 LS = 0.1 * S / L:RS = (L - X - D) * E * S / L / HH: IF RS > 1 - E * F * S / HH THEN
  RS = 1 - E * F * S / HH
17330 FOR V = RS TO LS STEP - R
17340 GOSUB 17600: IF BB > Q THEN Q = BB:V1 = V
17350 IF BB < Q THEN 17370
17360 NEXT V
17370 IF Q > Q2 THEN Q2 = Q
17380 V = V1:Q = 0
17390 LS = V * L * HH / S / (L - X - D): IF LS < HH / S THEN LS = HH / S
17400 RS = (1 - V) * HH / F / S: IF RS > 0.8 THEN RS = 0.8
17410 FOR E = LS TO RS STEP R
17420 GOSUB 17600: IF BB > Q THEN Q = BB:E1 = E
17430 IF BB < Q THEN 17450
17440 NEXT E
17450 IF Q > Q2 THEN Q2 = Q
17460 E = E1:Q = 0
17470 RS = (1 - V) * HH / E / S: IF RS > (X + D) / L THEN RS = (X + D) / L
17480 IF RS > X * HH / Y / L THEN RS = X * HH / Y / L
17490 FOR F = RS TO X / L STEP - R
17500 GOSUB 17600: IF BB > Q THEN Q = BB:F1 = F
17510 IF BB < Q THEN 17530
17520 NEXT F
17530 IF Q > Q2 THEN Q2 = Q
17540 F = F1:Q = 0:NC = NC + 1
17550 IF NC = 5 THEN 17570
17560 IF E2 < > E OR F2 < > F THEN E2 = E:F2 = F: GOTO 17320
17570 IF Q2 > Q1 THEN Q1 = Q2
17580 PRINT " PATTERN 7 , My = ";Q2
17590 Q2 = 0:NC = 0: GOTO 17640
17600 D = E * F * S / HH:J = X * HH / F / L / S:JJ = J * S:FF = F * L
17610 XX = CC * E / D - (HH - JJ) * YY * E / D + DD * E / V + GG * E / (1 - E) + ZZ -
  FF
17620 BB = WU * (SS * E * (3 - V - D) - DD + (FF - X) * (HH - JJ) ^ 2) / 6 / XX + (LL
  + P1 * (2 * H * JJ - (JJ - Y) ^ 2) - P4 * (FF - X) * (HH - JJ)) / 2 / XX: RETURN

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17630 REM  ## ANALYSIS SLAB TYPE 7 PATTERN 8 ##
17640 HH = S - Y - H:OO = X + O:LL = L * S ^ 2:SS = 3 * H * O * S:YY = 3 * H * O * X *
  Y / L:WW = 2 * P1 * H * X * Y
17650 IF L - OO < 0.3 * S OR HH < 0.5 * OO THEN 18030
17660 F = OO * Y / X / S: IF F > (Y + H) / S THEN F = (Y + H) / S
17670 IF S * OO / (HH + F * S) > L - 0.3 * S THEN 18030
17680 CC = S ^ 2 * (1 + I(1)) / U / L:DD = (1 + I(3)) * S ^ 2 / U / L:GG = (1 + I(4))
  * L:ZZ = (1 + I(2)) * L - O - X
17690 F2 = F:V = 0.3 * S / L:V2 = V
17700 LS = F * S / (HH + F * S): IF LS < 0.1 THEN LS = 0.1
17710 RS = (1 - V) * F * L / OO: IF RS > 0.9 THEN RS = 0.9
17720 FOR E = LS TO RS STEP R
17730 GOSUB 17990: IF BB > Q THEN Q = BB:E1 = E
17740 IF BB < Q THEN 17760
17750 NEXT E
17760 IF Q > Q2 THEN Q2 = Q
17770 E = E1:Q = 0
17780 LS = OO * E / (1 - V) / L: IF LS < Y / S THEN LS = Y / S
17790 RS = E * HH / S / (1 - E): IF RS > (Y + H) / S THEN RS = (Y + H) / S
17800 IF RS > OO * Y / X / S THEN RS = OO * Y / X / S
17810 FOR F = RS TO LS STEP - R
17820 GOSUB 17990: IF BB > Q THEN Q = BB:F1 = F
17830 IF BB < Q THEN 17850
17840 NEXT F
17850 IF Q > Q2 THEN Q2 = Q
17860 F = F1:Q = 0
17870 LS = 0.2 * S / L:RS = 1 - OO * E / F / L
17880 FOR V = RS TO LS STEP - R
17890 GOSUB 17990: IF BB > Q THEN Q = BB:V1 = V
17900 IF BB < Q THEN 17920
17910 NEXT V
17920 IF Q > Q2 THEN Q2 = Q
17930 V = V1:Q = 0:NC = NC + 1
17940 IF NC = 5 THEN 17960
17950 IF F < > F2 OR V2 < > V THEN F2 = F:V2 = V: GOTO 17700
17960 IF Q2 > Q1 THEN Q1 = Q2
17970 PRINT " PATTERN 8 , My = ";Q2
17980 Q2 = 0:NC = 0: GOTO 18030
17990 D = OO * E / F / L:J = OO * Y / F / S / L:JJ = J * L:FF = F * S
18000 XX = CC * E / D - E * S * (FF - Y) / U / D / L + DD * E / V + GG * E / (1 - E) +
  ZZ + JJ
18010 BB = WU * (LL * E * (3 - V - D) - SS * F - YY / J + (OO - JJ) * (FF - Y) ^ 2) /
  6 / XX + (WW / JJ + P4 * O * (FF + X * Y / JJ) + P2 * Y * (2 * O - (JJ - X) ^ 2 /
  JJ) + P3 * (2 * H * FF - (FF - Y) ^ 2)) / 2 / XX: RETURN
18020 REM  ## ANALYSIS SLAB TYPE 7 PATTERN 9 ##
18030 HH = Y + H:OO = X + O:LL = S - HH:SS = L - OO:YY = 2 * O * S ^ 2:QQ = 2 * H * S

18040 IF OO / 2 > LL OR Y * OO / X > HH THEN 18400
18050 CC = 2 * P2 * O * Y:DD = P4 * O * S:GG = (1 + I(3)) / U / L:ZZ = (1 + I(4)) * L
  :WW = (1 + I(2)) * L - O
18060 F = HH / S:E = F:F2 = F:E2 = E
18070 LS = 0.2 * S / L:RS = 1 - E * OO / F / L
18080 FOR V = RS TO LS STEP - R
18090 GOSUB 18350: IF BB > Q THEN Q = BB:V1 = V
18100 IF BB < Q THEN 18120
18110 NEXT V

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18120 IF Q > Q2 THEN Q2 = Q
18130 V = V1:Q = 0
18140 LS = F * S / (LL + F * S): IF LS < 0.1 THEN LS = 0.1
18150 RS = F * L * (1 - V) / DD: IF RS > 0.9 THEN RS = 0.9
18160 FOR E = LS TO RS STEP R
18170 GOSUB 18350: IF BB > Q THEN Q = BB:E1 = E
18180 IF BB < Q THEN 18200
18190 NEXT E
18200 IF Q > Q2 THEN Q2 = Q
18210 E = E1:Q = 0
18220 LS = E * DD / L / (1 - V): IF LS < Y * DD / S / X THEN LS = Y * DD / S / X
18230 RS = E * LL / S / (1 - E): IF RS > HH / S THEN RS = HH / S
18240 FOR F = RS TO LS STEP -R
18250 GOSUB 18350: IF BB > Q THEN Q = BB:F1 = F
18260 IF BB < Q THEN 18280
18270 NEXT F
18280 IF Q > Q2 THEN Q2 = Q
18290 F = F1:Q = 0:NC = NC + 1
18300 IF NC = 5 THEN 18320
18310 IF E2 < > E OR F2 < > F THEN E2 = E:F2 = F: GOTO 18070
18320 IF Q2 > Q1 THEN Q1 = Q2
18330 PRINT " PATTERN 9 , My = ";Q2
18340 Q2 = 0:NC = 0: GOTO 18400
18350 J = F * X / DD:D = E * DD / F / L:EE = E * S ^ 2:FF = F * S:JJ = J * S
18360 XX = EE * (1 + I(1) + J - F) / U / D / L + EE * GG / V + E * ZZ / (1 - E) + WW
18370 BB = WU * (EE * L * (3 - V - D) - 3 * D * S * (HH - FF) * (F + J) - 3 * D * (JJ
  ^ 2 - Y ^ 2) - YY * (F - J) * (F + 2 * J)) / 6 / XX
18380 BB = BB + (CC + DD * (F + J) + P1 * (QQ * J - (JJ - Y) ^ 2) + P3 * (QQ * F - (F
  F - Y) ^ 2)) / 2 / XX: RETURN
18390 REM ## ANALYSIS SLAB TYPE 7 PATTERN 10 ##
18400 HH = Y + H:DD = X + D:LL = L ^ 2 * S:SS = H * L:YY = 2 * D * L:QQ = 2 * P1 * H *
  X
18410 IF L - DD < 0.2 * S OR X * HH / Y > DD THEN 18750
18420 CC = ((1 + I(1)) * S - H) / U:DD = L ^ 2 / S:ZZ = (1 + I(3)) * S / U:WW = (1 +
  I(4)) * L ^ 2 / S
18430 F = DD / L:E = HH / S:F2 = F:E2 = E
18440 RS = E * S * (L - DD) / L / HH:LS = S / L / S: IF RS > 1 - E * F * S / HH THEN
  RS = 1 - E * F * S / HH
18450 FOR V = RS TO LS STEP -R
18460 GOSUB 18710: IF BB > Q THEN Q = BB:V1 = V
18470 IF BB < Q THEN 18490
18480 NEXT V
18490 IF Q > Q2 THEN Q2 = Q
18500 V = V1:Q = 0
18510 LS = X * HH / L / Y:RS = HH * (1 - V) / E / S: IF RS > DD / L THEN RS = DD / L
18520 FOR F = LS TO RS STEP R
18530 GOSUB 18710: IF BB > Q THEN Q = BB:F1 = F
18540 IF BB < Q THEN 18560
18550 NEXT F
18560 IF Q > Q2 THEN Q2 = Q
18570 F = F1:Q = 0
18580 LS = V * L * HH / S / (L - DD): IF LS < HH / S THEN LS = HH / S
18590 RS = HH * (1 - V) / F / S: IF RS > 0.9 THEN RS = 0.9
18600 FOR E = LS TO RS STEP R
18610 GOSUB 18710: IF BB > Q THEN Q = BB:E1 = E

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18620 IF BB < Q THEN 18640
18630 NEXT E
18640 IF Q > Q2 THEN Q2 = Q
18650 E = E1:Q = 0:NC = NC + 1
18660 IF NC = 5 THEN 18680
18670 IF E2 < > E OR F2 < > F THEN E2 = E:F2 = F: GOTO 18440
18680 IF Q2 > Q1 THEN Q1 = Q2
18690 PRINT " PATTERN 10 , My = ";Q2
18700 Q2 = 0:NC = 0: GOTO 18750
18710 D = E * F * S / HH:J = F * Y / HH:FF = F * L:JJ = J * L:EE = F + J:VV = F - J
18720 XX = 2 * D * (CC / D + DD * (1 + I(2) - VV) / E + ZZ / V + WW / (1 - E))
18730 BB = WU * (LL * D * (3 - V - D) - 3 * SS * (OO - FF) * EE - 3 * H * (JJ ^ 2 - X
      ^ 2) - 2 * SS * L * VV * (EE + J)) / 3 / XX
18740 BB = BB + (QQ + P3 * SS * EE + P2 * (YY * J - (JJ - X) ^ 2) + P4 * (YY * F - (F
      - X) ^ 2)) / XX: RETURN
18750 REM ## ANALYSIS SLAB TYPE 7 PATTERN 11 ##
18760 HH = S - Y - H:OO = L - X - O:LL = X * S ^ 2:SS = 2 * H * S:YY = S ^ 2 / U:CC =
      L - O + I(4) * L:DD = L - O + I(2) * L
18770 IF OO > S OR Y + H < 0.2 * S THEN 19120
18780 F = (Y + H / 2) / S:J = 1 - F:F2 = F:J2 = J:WW = S ^ 2 * OO
18790 RS = F / (J + F):LS = F * HH / J / S: IF LS < Y / S THEN LS = Y / S
18800 FOR V = LS TO RS STEP R
18810 GOSUB 19070: IF BB > Q THEN Q = BB:V1 = V
18820 IF BB < Q THEN 18840
18830 NEXT V
18840 IF Q > Q2 THEN Q2 = Q
18850 V = V1:Q = 0
18860 LS = J * V / (1 - V): IF LS < Y / S THEN LS = Y / S
18870 RS = V * J * S / HH: IF RS > 1 - J THEN RS = 1 - J
18880 FOR F = RS TO LS STEP - R
18890 GOSUB 19070: IF BB > Q THEN Q = BB:F1 = F
18900 IF BB < Q THEN 18920
18910 NEXT F
18920 IF Q > Q2 THEN Q2 = Q
18930 F = F1:Q = 0
18940 LS = F * HH / V / S: IF LS < HH / S THEN LS = HH / S
18950 RS = F * (1 - V) / V: IF RS > 1 - F THEN RS = 1 - F
18960 FOR J = RS TO LS STEP - R
18970 GOSUB 19070: IF BB > Q THEN Q = BB:J1 = J
18980 IF BB < Q THEN 19000
18990 NEXT J
19000 IF Q > Q2 THEN Q2 = Q
19010 J = J1:Q = 0:NC = NC + 1
19020 IF NC = 5 THEN 19040
19030 IF F < > F2 OR J2 < > J THEN F2 = F:J2 = J: GOTO 18790
19040 IF Q2 > Q1 THEN Q1 = Q2
19050 PRINT " PATTERN 11 , My = ";Q2
19060 Q2 = 0:NC = 0: GOTO 19120
19070 E = V * J / F:EE = V / E:VV = V + E:FF = F + J:JJ = F * S
19080 XX = V * YY * (VV + I(3)) / OO + F * YY * (FF + I(1)) / X + EE * CC + DD
19090 BB = WU * (F * LL * (3 - FF) + V * WW * (3 - VV) + 3 * O * (Y ^ 2 + EE * HH ^ 2
      )) / 6 / XX
19100 BB = BB + (P1 * (F * SS - (JJ - Y) ^ 2 - EE * (J * S - HH) ^ 2) + P3 * (V * SS -
      (V * S - Y) ^ 2 - EE * (E * S - HH) ^ 2) + 2 * O * (P2 * Y + EE * P4 * HH)) / 2 /
      XX: RETURN

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19110 REM  ## ANALYSIS SLAB TYPE 7 PATTERN 12 ##
19120 HH = Y + H:DD = L - X - D:LL = S - HH:SS = 3 * Q * X * Y ^ 2:YY = 2 * P2 * Q *
      X * Y
19130 IF DD > 1.2 * S THEN 19490
19140 CC = LL + I(1) * S:DD = (1 + I(2)) * X * L - D * X:GG = LL + I(3) * S:ZZ = L *
      S
19150 E = Y / S:J = X / L:E2 = E:J2 = J
19160 LS = E * J * DD / X / (1 - J): IF LS < Y / S THEN LS = Y / S
19170 RS = E * J * L / X: IF RS > HH / S THEN RS = HH / S
19180 FOR V = LS TO RS STEP R
19190 GOSUB 19440: IF BB > Q THEN Q = BB:V1 = V
19200 IF BB < Q THEN 19220
19210 NEXT V
19220 IF Q > Q2 THEN Q2 = Q
19230 V = V1:Q = 0
19240 LS = V * X / J / L: IF LS < Y / S THEN LS = Y / S
19250 RS = V * X * (1 - J) / J / DD: IF RS > HH / S THEN RS = HH / S
19260 FOR E = RS TO LS STEP - R
19270 GOSUB 19440: IF BB > Q THEN Q = BB:E1 = E
19280 IF BB < Q THEN 19300
19290 NEXT E
19300 IF Q > Q2 THEN Q2 = Q
19310 E = E1:Q = 0
19320 RS = V * X / (V * X + E * DD):LS = V * X / E / L: IF LS < X / L THEN LS = X / L

19330 FOR J = LS TO RS STEP R
19340 GOSUB 19440: IF BB > Q THEN Q = BB:J1 = J
19350 IF BB < Q THEN 19370
19360 NEXT J
19370 IF Q > Q2 THEN Q2 = Q
19380 J = J1:Q = 0:NC = NC + 1
19390 IF NC = 5 THEN 19410
19400 IF E2 < > E OR J2 < > J THEN E2 = E:J2 = J: GOTO 19160
19410 IF Q2 > Q1 THEN Q1 = Q2
19420 PRINT " PATTERN 12 , My = ";Q2
19430 Q2 = 0:NC = 0: GOTO 19490
19440 F = E * J * DD / V / X:EE = E * S:JJ = J * L:VV = V / E:FF = V * S
19450 XX = (CC + EE) / U + DD / EE + J * (GG + FF) / U / F + JJ * L * (I(4) + F + J) /
      LL
19460 BB = WU * (JJ * L * LL * (3 - F - J) + VV * X * DD * (3 * HH - FF) + X ^ 2 * (3
      * HH - EE) + SS / EE) / 6 / XX
19470 BB = BB + (P1 * X * (2 * H - (EE - Y) ^ 2 / EE) + P3 * X * (2 * VV * H - (FF -
      Y) ^ 2 / EE) + P4 * (2 * Q * JJ - (JJ - X) ^ 2 - J / F * (F * L - DD) ^ 2) + YY /
      EE) / 2 / XX: RETURN
19480 REM  ## ANALYSIS SLAB TYPE 7 PATTERN 13 ##
19490 HH = S - Y - H:DD = L - X - D:LL = 3 * (X + D):SS = 3 * H * Y * X ^ 2:YY = 2 *
      P1 * H * X * Y
19500 IF DD > S OR Y + H < 0.2 * S THEN 19860
19510 CC = ((1 + I(1)) * Y * S - H * Y) / U:DD = DD + I(4) * L:ZZ = S / U / DD:WW = 0
      D + I(2) * L
19520 V = X / L:E = V:E2 = E:V2 = V
19530 RS = E * Y / (V * HH + E * Y):LS = E * Y / V / S: IF LS < Y / S THEN LS = Y / S

19540 FOR F = RS TO LS STEP - R
19550 GOSUB 19810: IF BB > Q THEN Q = BB:F1 = F

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19560 IF BB < Q THEN 19580
19570 NEXT F
19580 IF Q > Q2 THEN Q2 = Q
19590 F = F1:Q = 0
19600 LS = V * F * HH / Y / (1 - F): IF LS < X / L THEN LS = X / L
19610 RS = V * F * S / Y: IF RS > (X + 0) / L THEN RS = (X + 0) / L
19620 FOR E = LS TO RS STEP R
19630 GOSUB 19810: IF BB > Q THEN Q = BB:E1 = E
19640 IF BB < Q THEN 19660
19650 NEXT E
19660 IF Q > Q2 THEN Q2 = Q
19670 E = E1:Q = 0
19680 LS = E * Y / F / S: IF LS < X / L THEN LS = X / L
19690 RS = E * Y * (1 - F) / F / HH: IF RS > (X + 0) / L THEN RS = (X + 0) / L
19700 FOR V = LS TO RS STEP R
19710 GOSUB 19810: IF BB > Q THEN Q = BB:V1 = V
19720 IF BB < Q THEN 19740
19730 NEXT V
19740 IF Q > Q2 THEN Q2 = Q
19750 V = V1:Q = 0:NC = NC + 1
19760 IF NC = 5 THEN 19780
19770 IF V2 < > V OR E2 < > E THEN V2 = V:E2 = E: GOTO 19530
19780 IF Q2 > Q1 THEN Q1 = Q2
19790 PRINT " PATTERN 13 , My = ";Q2
19800 Q2 = 0:NC = 0: GOTO 19860
19810 J = V * F * HH / E / Y:VV = V * L:FF = F * S:EE = E * L:JJ = E * Y / V
19820 XX = CC / VV + F * (DD + EE) / J + ZZ * FF * (I(3) + F + J) + WW + VV
19830 BB = WU * (FF * S * DD * (3 - F - J) + Y ^ 2 * (LL - VV) + JJ * HH * (LL - EE) +
SS / VV) / 6 / XX
19840 BB = BB + (YY / VV + P2 * Y * (2 * 0 - (VV - X) ^ 2 / VV) + P4 * Y / V * (2 * E
* 0 - (EE - X) ^ 2 / L) + P3 * (2 * H * FF - (FF - Y) ^ 2 + (J * S - HH) ^ 2 * F
/ J)) / 2 / XX: RETURN
19850 REM ## ANALYSIS SLAB TYPE 7 PATTERN 14 ##
19860 HH = S - H - Y:DD = L - X - 0:LL = 3 * H * DD ^ 2:SS = 3 * H * X ^ 2:YY = 2 * P
1 * H * X
19870 IF DD > S OR Y < 0.3 * DD THEN 20230
19880 CC = 2 * P3 * H * DD:DD = 2 * 0:GG = ((1 + I(1)) * S - H) / U:ZZ = ((1 + I(3)) *
S - H) / U:WW = L / HH
19890 V = (X + 0 / 2) / L:F = 1 - V:V2 = V:F2 = F
19900 LS = V * DD / F / L:RS = V / (V + F): IF LS < X / L THEN LS = X / L
19910 FOR E = LS TO RS STEP R
19920 GOSUB 20180: IF BB > Q THEN Q = BB:E1 = E
19930 IF BB < Q THEN 19950
19940 NEXT E
19950 IF Q > Q2 THEN Q2 = Q
19960 E = E1:Q = 0
19970 LS = F * E / (1 - E): IF LS < X / L THEN LS = X / L
19980 RS = F * E * L / DD: IF RS > 1 - F THEN RS = 1 - F
19990 FOR V = LS TO RS STEP R
20000 GOSUB 20180: IF BB > Q THEN Q = BB:V1 = V
20010 IF BB < Q THEN 20030
20020 NEXT V
20030 IF Q > Q2 THEN Q2 = Q
20040 V = V1:Q = 0
20050 LS = V * DD / E / L: IF LS < DD / L THEN LS = DD / L
20060 RS = V * (1 - E) / E: IF RS > 1 - V THEN RS = 1 - V

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20070 FOR F = LS TO RS STEP R
20080 GOSUB 20180: IF BB > Q THEN Q = BB:F1 = F
20090 IF BB < Q THEN 20110
20100 NEXT F
20110 IF Q > Q2 THEN Q2 = Q
20120 F = F1:Q = 0:NC = NC + 1
20130 IF NC = 5 THEN 20150
20140 IF V2 < > V OR F2 < > F THEN V2 = V:F2 = F: GOTO 19900
20150 IF Q2 > Q1 THEN Q1 = Q2
20160 PRINT " PATTERN 14 , My = ";Q2
20170 Q2 = 0:NC = 0: GOTO 20230
20180 J = F * E / V:EE = E * L:VV = V * L:FF = V / F
20190 XX = GG + VV * L * (I(2) + V + F) / Y + FF * ZZ + EE * WW * (I(4) + E + J)
20200 BB = WU * (VV * Y * L * (3 - V - F) + EE * L * HH * (3 - E - J) + LL * FF + SS)
/ 6 / XX
20210 BB = BB + (YY + CC * FF + P2 * (VV * DD - (VV - X) ^ 2 - FF * (F * L - DD) ^ 2)
+ P4 * (EE * DD - (EE - X) ^ 2 - E * (J * L - DD) ^ 2 / J)) / 2 / XX: RETURN
20220 REM ## ANALYSIS SLAB TYPE 7 PATTERN 15 ##
20230 HH = Y + H:DD = X + D:LL = S - HH:SS = L - DD:YY = 3 * H * X ^ 2:CC = 2 * P1 *
H * X:QQ = 2 * D * L
20240 IF SS > 1.2 * S OR Y < 0.3 * X THEN 20600
20250 DD = ((1 + I(1)) * S - H) / U:GG = SS + I(2) * L:ZZ = LL + I(3) * S:WW = L ^ 2 /
LL
20260 V = X / L:E = V:E2 = E:V2 = V
20270 LS = E * Y * SS / V / L / S / (1 - E): IF LS < Y / S THEN LS = Y / S
20280 RS = E * Y / V / S: IF RS > HH / S THEN RS = HH / S
20290 FOR F = LS TO RS STEP R
20300 GOSUB 20550: IF BB > Q THEN Q = BB:F1 = F
20310 IF BB < Q THEN 20330
20320 NEXT F
20330 IF Q > Q2 THEN Q2 = Q
20340 F = F1:Q = 0
20350 LS = E * Y * SS / F / L / S / (1 - E): IF LS < X / L THEN LS = X / L
20360 RS = E * Y / F / S: IF RS > DD / L THEN RS = DD / L
20370 FOR V = LS TO RS STEP R
20380 GOSUB 20550: IF BB > Q THEN Q = BB:V1 = V
20390 IF BB < Q THEN 20410
20400 NEXT V
20410 IF Q > Q2 THEN Q2 = Q
20420 V = V1:Q = 0
20430 RS = V * F * L * S / (V * F * L * S + Y * SS):LS = V * F * S / Y: IF LS < X / L
THEN LS = X / L
20440 FOR E = LS TO RS STEP R
20450 GOSUB 20550: IF BB > Q THEN Q = BB:E1 = E
20460 IF BB < Q THEN 20480
20470 NEXT E
20480 IF Q > Q2 THEN Q2 = Q
20490 E = E1:Q = 0:NC = NC + 1
20500 IF NC = 5 THEN 20520
20510 IF V2 < > V OR E2 < > E THEN V2 = V:E2 = E: GOTO 20270
20520 IF Q2 > Q1 THEN Q1 = Q2
20530 PRINT " PATTERN 15 , My = ";Q2
20540 Q2 = 0:NC = 0: GOTO 20600
20550 J = E * Y * SS / V / F / L / S:EE = E * L:VV = V * L:FF = F * S:JJ = E / J
20560 XX = DD + VV * (GG + VV) / Y + JJ * (ZZ + FF) / U + EE * L * (I(4) + E + J) / L

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20570 BB = WU * (EE * L * LL * (3 - E - J) + VV * Y * (3 * DD - VV) + JJ * SS ^ 2 * (
  3 * HH - FF) + YY) / 6 / XX
20580 BB = BB + (CC + P2 * (QQ * V - (VV - X) ^ 2) + P3 * VV * (2 * H * FF - (FF - Y)
  ^ 2) / Y + P4 * (QQ * E - (EE - X) ^ 2 - JJ * (J * L - SS) ^ 2)) / 2 / XX: RETURN

20590 REM  ## ANALYSIS SLAB TYPE 7 PATTERN 16 ##
20600 HH = Y + H:DD = X + D:LL = S - HH:SS = L - DD:YY = 3 * D * Y ^ 2:CC = 2 * P2 *
  D * Y
20610 IF SS > S OR X < 0.2 * Y THEN 20910
20620 DD = LL + I(1) * S:GG = S / U / SS:ZZ = SS + I(4) * L:WW = (1 + I(2)) * L - D
20630 V = Y / S:E = X / L:V2 = V:E2 = E
20640 RS = V * E * L * S / (V * E * L * S + X * LL):LS = V * E * L / X: IF LS < Y / S
  THEN LS = Y / S
20650 FOR F = LS TO RS STEP R
20660 GOSUB 20930: IF BB > Q THEN Q = BB:F1 = F
20670 IF BB < Q THEN 20690
20680 NEXT F
20690 IF Q > Q2 THEN Q2 = Q
20700 F = F1:Q = 0
20710 LS = F * X * LL / E / L / S / (1 - F): IF LS < Y / S THEN LS = Y / S
20720 RS = F * X / E / L: IF RS > HH / S THEN RS = HH / S
20730 FOR V = LS TO RS STEP R
20740 GOSUB 20930: IF BB > Q THEN Q = BB:V1 = V
20750 IF BB < Q THEN 20770
20760 NEXT V
20770 IF Q > Q2 THEN Q2 = Q
20780 V = V1:Q = 0
20790 LS = F * X * LL / V / L / S / (1 - F): IF LS < X / L THEN LS = X / L
20800 RS = F * X / V / L: IF RS > DD / L THEN RS = DD / L
20810 FOR E = LS TO RS STEP R
20820 GOSUB 20930: IF BB > Q THEN Q = BB:E1 = E
20830 IF BB < Q THEN 20850
20840 NEXT E
20850 IF Q > Q2 THEN Q2 = Q
20860 E = E1:Q = 0:NC = NC + 1
20870 IF NC = 5 THEN 20890
20880 IF V2 < > V OR E2 < > E THEN V2 = V:E2 = E: GOTO 20640
20890 IF Q2 > Q1 THEN Q1 = Q2
20900 PRINT " PATTERN 16 , My = ";Q2
20910 PRINT D$;"PR#0"
20920 Q2 = 0:NC = 0: GOTO 20980
20930 J = F * X * LL / V / E / L / S:VV = V * S:FF = F * S:EE = E * L:JJ = F / J
20940 XX = VV * (DD + VV) / U / X + FF * GG * (I(3) + F + J) + JJ * (ZZ + EE) + WW
20950 BB = WU * (FF * S * SS * (3 - F - J) + VV * X * (3 * HH - VV) + JJ * LL ^ 2 * (
  3 * DD - EE) + YY) / 6 / XX
20960 BB = BB + (CC + P1 * (2 * H * VV - (VV - Y) ^ 2) + P4 * VV * (2 * D * EE - (EE -
  X) ^ 2) / X + P3 * (2 * H * FF - (FF - Y) ^ 2 - JJ * (J * S - LL) ^ 2)) / 2 / XX:
  RETURN
20970 REM  ## COMPUTE LENGTH OF TOP STEEL ##
20980 P1 = P5:P2 = P6:P3 = P7:P4 = P8:U = U1: PRINT
20990 IF N > 1 THEN 21030
21000 FOR J = 1 TO 4
21010 II(J) = I(J):I(J) = 0: NEXT J
21020 QP = Q1:Q1 = 2 * Q1
21030 IF QP > = Q1 THEN 21530
21040 IF II(1) + II(2) + II(3) + II(4) = 0 THEN 21530

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21050 LX = LX + L1 / 24; LY = LY + S1 / 24
21060 IF II(1) > 0 THEN L = L1 - LX; X = X1 - LX
21070 IF II(2) > 0 THEN S = S1 - LY; Y = Y1 - LY
21080 IF II(3) > 0 THEN L = L - LX; L3 = L2 - LX
21090 IF II(4) > 0 THEN S = S - LY; S3 = S2 - LY
21100 IF L < = 0 OR S < = 0 THEN 21530
21110 IF X < = T / 100 AND Y < = T / 100 THEN 21130
21120 GOTO 21140
21130 IF L3 < = T / 100 AND S3 < = T / 100 THEN 21530
21140 IF II(1) > 0 AND LX > = X1 + O1 THEN 21480
21150 IF II(2) > 0 AND LY > = Y1 + H1 THEN 21480
21160 IF II(3) > 0 AND LX > = L1 - X1 THEN 21480
21170 IF II(4) > 0 AND LY > = S1 - Y1 THEN 21480
21180 IF X < = 0 AND L3 < = 0 THEN L = L1 - 2 * LX; GOTO 21200
21190 GOTO 21240
21200 IF Y > = T / 100 THEN S = Y; P = P2; GOSUB 13780; Q3 = Q1
21210 IF S3 > = T / 100 THEN S = S3; P = P4; GOSUB 13780
21220 IF Q3 > Q1 THEN Q1 = Q3
21230 Q3 = 0; GOTO 20980
21240 IF Y < = 0 AND S3 < = 0 THEN L = S1 - 2 * LY; GOTO 21260
21250 GOTO 21300
21260 IF X > = T / 100 THEN S = X; P = P1; U = 1 / U1; GOSUB 13780; Q3 = Q1
21270 IF L3 > = T / 100 THEN S = L3; P = P3; U = 1 / U1; GOSUB 13780
21280 IF Q3 > Q1 THEN Q1 = Q3
21290 Q3 = 0; GOTO 20980
21300 IF X < = 0 AND Y < = 0 THEN L = L + G; S = S + G; O = X1 + O1 - LX; H = Y1 + H1
  - LY; P1 = 0; P2 = 0; X = G; Y = G; GOTO 21380
21310 IF Y < = 0 AND L3 < = 0 THEN L = L + G; S = S + G; O = L2 + O1 - LX; H = Y1 + H
  1 - LY; P2 = 0; P3 = 0; Y = G; GOTO 21380
21320 IF L3 < = 0 AND S3 < = 0 THEN L = L + G; S = S + G; O = L2 + O1 - LX; H = S2 +
  H1 - LY; P3 = 0; P4 = 0; GOTO 21380
21330 IF X < = 0 AND S3 < = 0 THEN L = L + G; S = S + G; O = X1 + O1 - LX; H = S2 + H
  1 - LY; P1 = 0; P4 = 0; X = G; GOTO 21380
21340 IF X < = 0 THEN L = L + G; O = X1 + O1 - LX; X = G; P1 = 0; GOTO 21380
21350 IF Y < = 0 THEN S = S + G; H = Y1 + H1 - LY; Y = G; P2 = 0; GOTO 21380
21360 IF L3 < = 0 THEN L = L + G; O = L2 + O1 - LX; P3 = 0; GOTO 21380
21370 IF S3 < = 0 THEN S = S + G; H = S2 + H1 - LY; P4 = 0
21380 IF L < T / 100 + O AND S < T / 100 + H THEN 21530
21390 REM ## CHECK SPAN Lx MORE THAN SPAN Ly AND CHANGE DATA ##
21400 IF S > L THEN 21420
21410 GOTO 21440
21420 CC = P1; P1 = P2; P2 = P3; P3 = P4; P4 = CC; CC = L; DD = 0; EE = X; L = S; S = CC; X = Y
  ; Y = CC - DD - EE; O = H; H = DD; U = 1 / U1
21430 REM ## CHECK AND CHANGE CO-ORDINATE OF OPENING CENTER ##
21440 X = X + O / 2; Y = Y + H / 2; GOSUB 15030
21450 X = X - O / 2; Y = Y - H / 2
21460 GOTO 15220
21470 REM ## CLOSE FORM FOR SIMPLE SUPPORT SLAB TYPE 1 ##
21480 Q1 = WU * (S ^ 4 / L ^ 2 / 24 / U1 * (SQR (1 + 3 * U1 * (L / S) ^ 2) - 1) ^ 2)

21490 BB = WU * (L ^ 4 / S ^ 2 / 24 / U1 ^ 2 * (SQR (1 + 3 * U1 * (S / L) ^ 2) - 1) ^
  2)
21500 IF BB > Q1 THEN Q1 = BB
21510 PRINT " SIMPLY SUPPORT SLAB TYPE 1 , My = "; Q1
21520 N = N + 1; GOTO 20980

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21530 PRINT D$;"PR#1"  
21540 PRINT : PRINT "MOMENT FOR DESIGN (My) = ";QP  
21550 REM ## DESIGN TOP STEEL ##  
21560 GOSUB 13640:NT = 0  
21570 FOR J = 1 TO 4  
21580 IF II(J) = 0 THEN 21640  
21590 IF J = 1 OR J = 3 THEN M(J) = QP * II(J) / U1: GOTO 21610  
21600 M(J) = QP * II(J)  
21610 D = T - 2  
21620 GOSUB 13690: IF NT = 1 THEN 21560  
21630 A(J) = AA  
21640 NEXT J  
21650 REM ## DESIGN BOTTOM STEEL ##  
21660 FOR J = 1 TO 2  
21670 IF J = 2 THEN M(J) = QP / U1:D = T - 3: GOTO 21690  
21680 M(J) = QP:D = T - 2  
21690 GOSUB 13690: IF NT = 1 THEN 21560  
21700 B(J) = AA: NEXT J  
21710 REM  
21720 REM *** PRINT RESULTS SLAB TYPE 7 ***  
21730 IF X2 > L1 / 2 AND Y2 > S1 / 2 THEN CC = A(1):DD = A(2):A(1) = A(3):A(2) = A(4  
):A(3) = CC:A(4) = DD: GOTO 14840  
21740 IF X2 > L1 / 2 THEN CC = A(1):A(1) = A(3):A(3) = CC: GOTO 14840  
21750 IF Y2 > S1 / 2 THEN CC = A(2):A(2) = A(4):A(4) = CC: GOTO 14840  
21760 GOTO 14840
```

ภาคผนวก ค

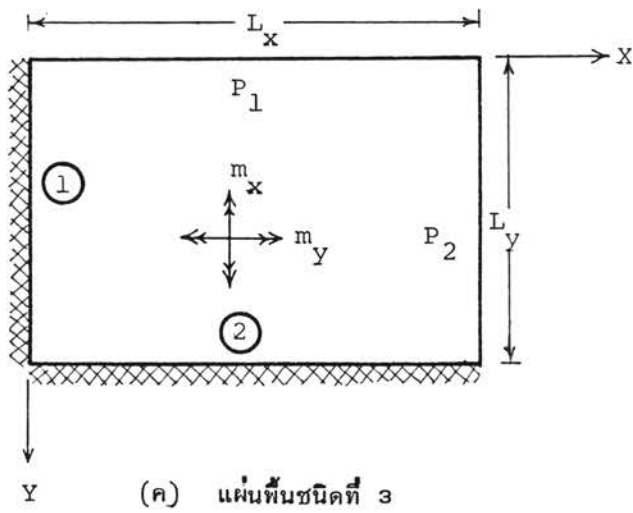
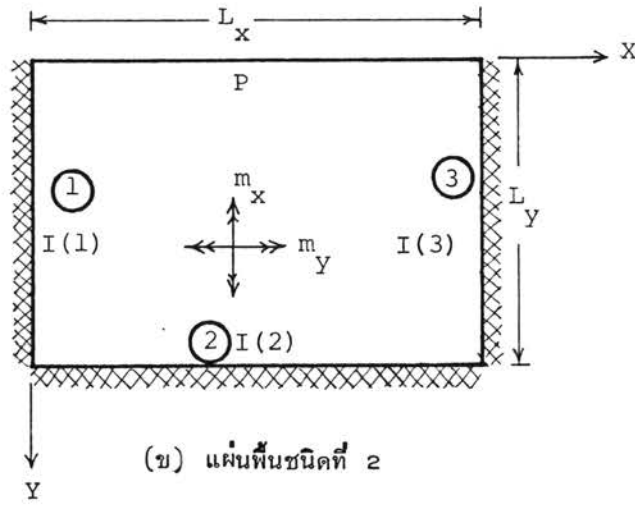
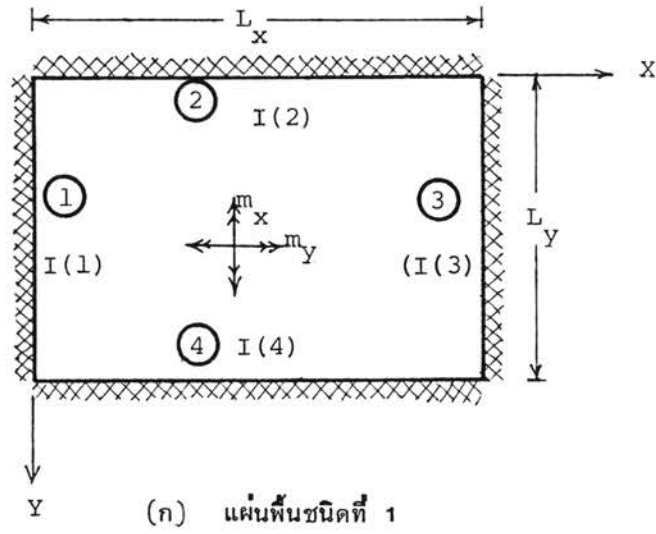
วิธีการใช้โปรแกรมคอมพิวเตอร์

การสั่งให้เครื่องทำงานใช้คำสั่ง RUN โปรแกรมชื่อ YTAD จากแผ่นจานแม่เหล็ก เพื่อทำการอ่านข้อมูล พลอตรูปและคำนวณต่อไป

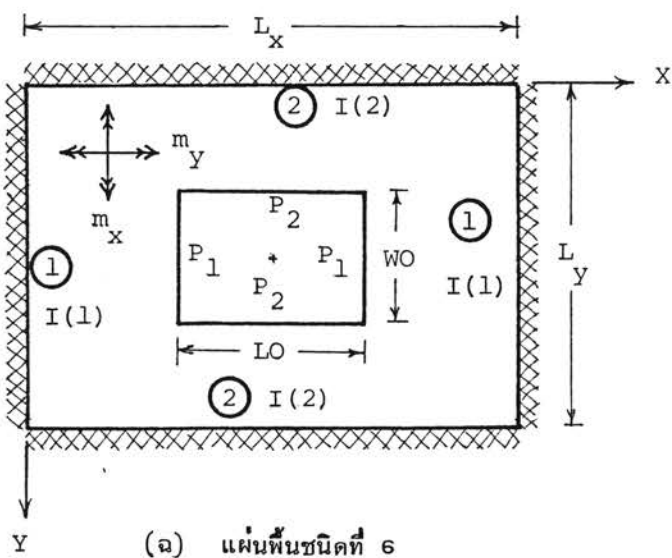
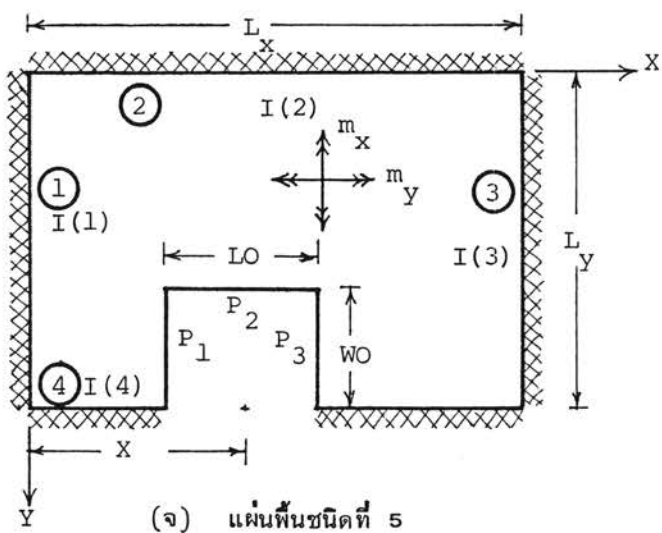
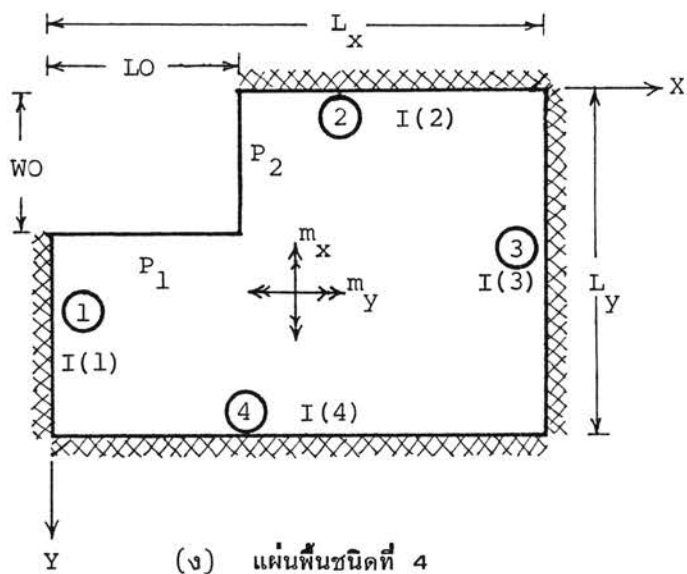
วิธีการป้อนข้อมูล เครื่องกับผู้ใช้จะทำงานร่วมกันในลักษณะถาม-ตอบ ทีละประโยค ในเริ่มแรก เครื่องจะถามชนิดของแผ่นพื้นก่อนแล้วตามด้วยคุณสมบัติของ เหล็ก เสริม กำลังของ คอนกรีต และข้อมูลของแผ่นพื้น ซึ่งประกอบด้วย รูปทรงทางเรขาคณิตตลอดจนสภาวะเงื่อนไข การยึดรั้งที่ขอบของที่รองรับของแผ่นพื้นแต่ละชนิดรวมทั้งน้ำหนักที่จะให้แผ่นพื้นรับ ดังข้อมูลของ แผ่นพื้นแต่ละชนิดที่แสดงในรูปที่ ต-1

นอกจากข้อมูลทั่วไปแล้ว ยังมีข้อมูลประเภทเลือกป้อน โดยป้อนคำตอบ (Y/N)

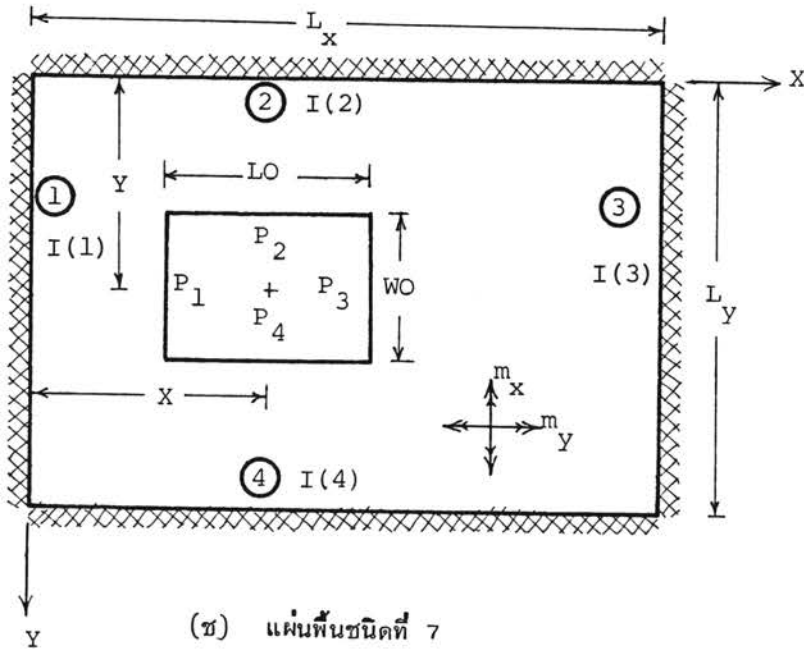
1. ผู้ใช้สามารถเปลี่ยนตัวประกอบภาระสำหรับน้ำหนัก (LOAD FACTOR) ซึ่งใน เครื่องจะกำหนดตัวประกอบภาระสำหรับน้ำหนักถาวรเท่ากับ 1.4 และตัวประกอบภาระสำหรับ น้ำหนักบรรทุกจรเท่ากับ 1.7
2. ผู้ใช้สามารถเปลี่ยนความหนาแน่นสุดของแผ่นพื้น (INITIAL SLAB THICKNESS) ในเครื่องจะกำหนดความหนาแน่นสุด เท่ากับมาตรฐานการออกแบบ ACI 1983
3. ผู้ใช้สามารถ เปลี่ยนช่วงการ เปลี่ยนค่าตัวแปรในการวิเคราะห์รูปบยบยิลด์ไลน์ (STEP SIZE FOR ITERATION) ในเครื่องจะกำหนดไว้เท่ากับ 0.05



รูปที่ ค-1 รูปประกอบการบอข้อมูลของแผ่นพื้น



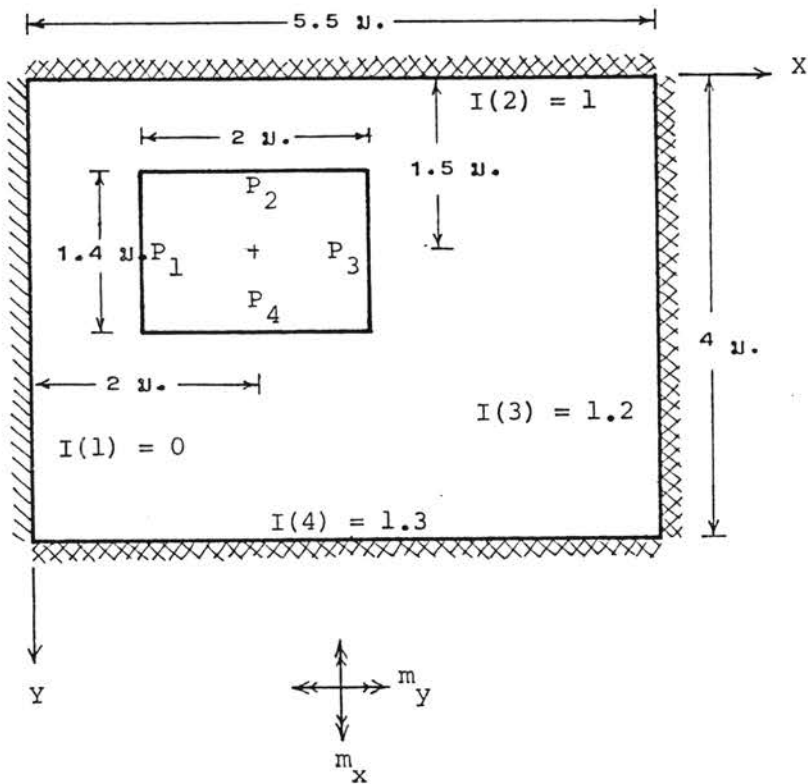
รูปที่ ค-1 (ต่อ) รูปประกอบการบ่อนข้อมูลของแผ่นพื้น



- หมายเหตุ
- I(1), I(2), I(3) และ I(4) คืออัตราส่วนการรับแรงดัดที่ขอบของที่รองรับต่อการรับแรงดัดภายในแผ่นพื้น
 - P, P₁, P₂, P₃ และ P₄ คือน้ำหนัก เป็นแนวเส้นที่กระทำบนขอบอิสระหรือขอบของช่องเปิด
 - สัญลักษณ์ ○ แสดงชื่อด้านของแผ่นพื้น
 - การตั้งรูปในแผ่นพื้นชนิดที่ 7 ให้ $L_x \geq L_y$

รูปที่ ค-1 (ต่อ) รูปประกอบการบ่อนข้อมูลของแผ่นพื้น

ตัวอย่างข้อมูลแผ่นพื้นชนิดที่ 7



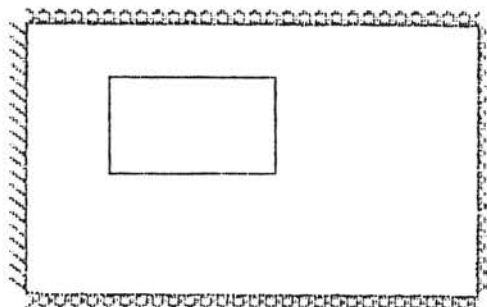
- กำลังคอนกรีตรูปทรงระบอบอก 200 กก./ซม^2 .
 - เหล็กข้อย้อยกำลังที่จุดยึด $3,000 \text{ กก./ซม}^2$.
 - รับน้ำหนักแผ่กระจายสม่ำเสมอ 400 กก./ม^2 .
 - รับน้ำหนักแนวเส้น $P_1, P_2, P_3, P_4 = 200, 150, 300, 250 \text{ กก./ม}$.
- ตามลำดับ

ตัวอย่างการป้อนข้อมูลแผ่นพื้นชนิดที่ 7

```

Please turn on Printer :
SLAB TYPE ..... = 7
STEEL TYPE. (RB= Round bar ;DB= Deform bar) . = DB
YIELD STRENGTH OF STEEL. (ksc.) ..... = 3000
TOP STEEL DIAMETER. (mm.) ..... = 10
BOTTOM STEEL DIAMETER. (mm.) ..... = 10
CYLINDER STRENGTH OF CONCRETE. (ksc.) . = 200
Do you want to input LOAD FACTOR ? (Y/N) N
DEAD LOAD FACTOR .. = 1.4
LIVE LOAD FACTOR .. = 1.7
LENGTH OF SPAN Lx. (meter) ..... = 5.5
LENGTH OF SPAN Ly. (meter) ..... = 4
CENTER CO-ORDINATE OF OPENING, (X,Y). (meter) = 2,1.5
LENGTH OF OPENING, LO. (meter) .. = 2
WIDTH OF OPENING, WO. (meter) ... = 1.4
UNIFORM LOAD. (kg/squar meter) .. = 400
LINE LOAD P1. (kg/meter) ..... = 200
LINE LOAD P2. (kg/meter) ..... = 150
LINE LOAD P3. (kg/meter) ..... = 300
LINE LOAD P4. (kg/meter) ..... = 250
VALUE I(1) ..... = 0
VALUE I(2) ..... = 1
VALUE I(3) ..... = 1.2
VALUE I(4) ..... = 1.3
RATIO My/Mx. .... = 1.4
Do you want to input SLAB THICKNESS ? (Y/N) N
INITIAL SLAB THICKNESS . (cm.) .. = 10
Do you want to input STEP SIZE for iteration ? (Y/N) N
STEP SIZE FOR ITERATION ..... = .05
Do you accept these DATA ? (Y/N) Y
    Do you want to PLOT DATA ? (Y/N) Y
  
```

 PLOT DATA



ประวัติ

นายสุธี ผลบำรุงวัชระ เกิดเมื่อวันที่ 28 มีนาคม พ.ศ. 2502 ที่จังหวัดฉะเชิงเทรา สำเร็จการศึกษาชั้นมัธยมศึกษาตอนปลาย (ม.ศ. 5) จากโรงเรียนเบญจมราชรังสฤษฎ์ (ฉะเชิงเทรา) ในเดือนมีนาคม พ.ศ. 2521 สำเร็จการศึกษาระดับปริญญาตรี สาขาวิศวกรรมโยธา จากมหาวิทยาลัยเชียงใหม่ ในเดือนมีนาคม พ.ศ. 2525

