Wood and Armer method

Wood and Armer proposed one of the most popular design methods that explicitly incorporate twisting moments in slab design. This method was developed by considering the normal moment yield criterion (Johansen's yield criterion) aiming to prevent yielding in all directions. At any point in the slab, the moment normal to a direction, resulting due to design moments M*x*, *My*, and M*xy*, must not exceed the ultimate normal resisting moment in that direction. The ultimate normal resisting moment is typically provided by ultimate resisting moments M*ux* and *Mu*α related to the reinforcement in the *x*- and α-directions.

Mx, My and Mxy are bending and twisting moments, usually obtained from a finite element or grillage analysis program. The sign convension needs to be altered if it is different from above. α is the angle of the transverse steel, measured clockwise, from the Mx axis.

M*x = Moment to be resisted by reinforcement in the x direction
M* α = Moment to be resisted by reinforcement in the a direction

NOTE :

α is measured clockwise from the x axis.
The superscript * refers to the moment of resistance to be provided in that direction

Bottom Steel

$M^*x = Mx + 2Mxy \cot\alpha + My \cot^2\alpha + |(Mxy + My \cot\alpha) / \sin\alpha|$

$M^*\alpha = (My / \sin^2\alpha) + |(Mxy + My \cot\alpha) / \sin\alpha|$

If $M^*x < 0$ then fix $M^*x = 0$

and $M^*\alpha = (My + |(Mxy + My \cot\alpha)^2 / (Mx + 2Mxy \cot\alpha + My \cot^2\alpha)|) / \sin^2\alpha$

If $M^*\alpha < 0$ then fix $M^*\alpha = 0$

and $M^*x = Mx + 2Mxy \cot\alpha + My \cot^2\alpha + |(Mxy + My \cot\alpha)^2 / My|$

Top Steel

$M^*x = Mx + 2Mxy \cot\alpha + My \cot^2\alpha - |(Mxy + My \cot\alpha) / \sin\alpha|$

$M^*\alpha = (My / \sin^2\alpha) - |(Mxy + My \cot\alpha) / \sin\alpha|$

If $M^*x > 0$ then fix $M^*x = 0$

and $M^*\alpha = (My - |(Mxy + My \cot\alpha)^2 / (Mx + 2Mxy \cot\alpha + My \cot^2\alpha)|) / \sin^2\alpha$

If $M^*\alpha > 0$ then fix $M^*\alpha = 0$

and $M^*x = Mx + 2Mxy \cot\alpha + My \cot^2\alpha - |(Mxy + My \cot\alpha)^2 / My|$

Ref :

Wood, R.H., "***The Reinforcement of Slabs in Accordance with a Pre-Determined Field of Moments***," *Concrete*, V. 2, No. 2, 1968, pp. 69-76. (discussion by Armer)