APPENDICES
APPENDIX I

CONVERSION OF MEASURED STRAINS TO STRESSES FOR CONCRETE UNDERLAY PAVEMENT

1. General:

The Young's modulus (E) & Poisson's ratio (\( \nu \)) for cement concrete are assumed to be \( 5 \times 10^6 \) psi and 0.2 respectively (para 2.5.12). The notations \( \sigma \) & \( \epsilon \) denote stress and strain respectively. Subscripts \( x \) & \( y \) denote the stress/strain in respective directions of rectangular co-ordinates.

2. Interior Loading:

For interior loading (with origin of the co-ordinates at the axis of loading):

\[
\epsilon_x = \frac{\sigma_x - \nu \sigma_y}{E} \quad \text{&} \quad \epsilon_y = \frac{\sigma_y - \nu \sigma_x}{E}
\]

Therefore, \( \epsilon_x + \nu \epsilon_y = (1-\nu^2) \frac{\sigma_x}{E} \)

Assuming that \( \epsilon_x \) & \( \epsilon_y \) are equal,

\[
\epsilon_{\max} = \frac{1-\nu}{E} \sigma_{\max}
\]

Or,

\[
\sigma_{\max} = \frac{E}{1-\nu} \epsilon_{\max} = 5 \times 10^6 \epsilon_{\max} = 6.25 \epsilon_{\max} \text{ psi}
\]

where \( \epsilon_{\max} \) is the strain in micro-inches per inch.

Continued...
Continued Appendix I

3. Edge Loading:

Assuming that the stress at the edge in the direction perpendicular to the edge is zero,

\[ \sigma_{\text{max}} = \frac{E}{\varepsilon} \]

Or,

\[ \sigma_{\text{max}} = E \varepsilon_{\text{max}}. \]

\[ = 5 \times 10^6 \varepsilon_{\text{max}}. \]

\[ = 5.0 \varepsilon_{\text{max}} \text{ psi.} \]

where \( \varepsilon_{\text{max}} \) is the strain measured along the edge in micro-inches per inch.

4. Corner Loading:

As for interior loading,

\[ \sigma_x = \frac{E}{1-\nu^2} (\varepsilon_x + u \varepsilon_y) \]

In this case, the axis \( x \) is along the corner diagonal and the axis \( y \) is perpendicular to the diagonal.

Assuming, after Spangler*, that \( \varepsilon_y = -\frac{1}{2} \varepsilon_x \),

\[ \sigma_y = \sigma_x = \frac{E}{1-\nu^2} \varepsilon_x (1-\frac{1}{2} u) \]

\[ = 5 \times 10^6 \varepsilon_{\text{max}}(0.90) \]

\[ = 4.685 \varepsilon_{\text{max}} \text{ psi.} \]

where \( \varepsilon_{\text{max}} \) is the maximum strain along the diagonal in micro-inches per inch.