The ***phase*** associated with the complex ***frequency-domain*** $\tilde{I}^{\parallel}_{a_{tot}}(x,\omega)$ is:

$$\varphi_{I_{a\,tot}}(x,\omega) \equiv \tan^{-1}\left(\frac{\operatorname{Im}\left\{\tilde{I}^{\parallel}_{a\,tot}(x,\omega)\right\}}{\operatorname{Re}\left\{\tilde{I}^{\parallel}_{a\,tot}(x,\omega)\right\}}\right) = \tan^{-1}\left(\frac{\frac{1}{2}\frac{|\tilde{A}|^2}{z_o}\left[2|\tilde{R}|\sin\left(2kx+\Delta\varphi^o_{BA}\right)\right]}{\frac{1}{2}\frac{|\tilde{A}|^2}{z_o}\left[\left\{1-|\tilde{R}|^2\right\}\right]}\right) = \tan^{-1}\left(\frac{\left[2|\tilde{R}|\sin\left(2kx+\Delta\varphi^o_{BA}\right)\right]}{\left[\left\{1-|\tilde{R}|^2\right\}\right]}\right)$$

Compare the above ***frequency-domain*** total/resultant complex longitudinal acoustic intensity expressions to those associated with the complex longitudinal ***specific*** acoustic impedance and complex longitudinal energy flow velocity:

$$\frac{\tilde{z}^{\parallel}_{a_{tot}}(x,\omega)}{z_o} = \frac{\left[\left\{1-|\tilde{R}|^2\right\}+2i|\tilde{R}|\sin\left(2kx+\Delta\varphi^o_{BA}\right)\right]}{\left[\left\{1+|\tilde{R}|^2\right\}-2|\tilde{R}|\cos\left(2kx+\Delta\varphi^o_{BA}\right)\right]} = \frac{\tilde{c}^{\parallel}_{a_{tot}}(x,\omega)}{c}$$

Since: $\vec{\tilde{I}}_a \equiv \frac{1}{2}\tilde{p}\vec{\tilde{u}}^*$ and $\vec{\tilde{z}}_a \equiv \frac{\tilde{p}}{\vec{\tilde{u}}} = \frac{\tilde{p}}{\vec{\tilde{u}}}\frac{\bullet\vec{\tilde{u}}^*}{\bullet\vec{\tilde{u}}^*} = \frac{\tilde{p}\vec{\tilde{u}}^*}{|\vec{\tilde{u}}|^2} = \frac{2\vec{\tilde{I}}_a}{|\vec{\tilde{u}}|^2}$, or: $\vec{\tilde{I}}_a(x,\omega) = \frac{1}{2}|\vec{\tilde{u}}(x,\omega)|^2\,\vec{\tilde{z}}_a(x,\omega)$,

For the situation ***here*** with counter-propagating 1-D monochromatic traveling plane waves, and using $k=\omega/c$:

$$\left|\tilde{u}^{\parallel}_{tot}(x,\omega)\right|^2 = \frac{|\tilde{A}|^2}{z_o^2}\left[1-2|\tilde{R}|\cos\left(2kx+\Delta\varphi_{BA}\right)+|\tilde{R}|^2\right] = \frac{|\tilde{A}|^2}{z_o^2}\left[\left\{1+|\tilde{R}|^2\right\}-2|\tilde{R}|\cos\left(2kx+\Delta\varphi_{BA}\right)\right]$$

Thus we see that, indeed:

$$\frac{2\tilde{I}^{\parallel}_{a_{tot}}(x,\omega)}{\left|\tilde{u}^{\parallel}_{tot}(x,\omega)\right|^2} = \frac{2\cdot\frac{1}{2}\frac{|\tilde{A}|^2}{z_o}\left[\left\{1-|\tilde{R}|^2\right\}+2i|\tilde{R}|\sin\left(2kx+\Delta\varphi^o_{BA}\right)\right]}{\frac{|\tilde{A}|^2}{z_o^2}\left[\left\{1+|\tilde{R}|^2\right\}-2|\tilde{R}|\cos\left(2kx+\Delta\varphi^o_{BA}\right)\right]} = z_o\frac{\left[\left\{1-|\tilde{R}|^2\right\}+2i|\tilde{R}|\sin\left(2kx+\Delta\varphi^o_{BA}\right)\right]}{\left[\left\{1+|\tilde{R}|^2\right\}-2|\tilde{R}|\cos\left(2kx+\Delta\varphi^o_{BA}\right)\right]} = \tilde{z}^{\parallel}_{a_{tot}}(x,\omega)$$

*i.e.* that:

$$\frac{2\tilde{I}^{\parallel}_{a_{tot}}(x,\omega)}{\left|\tilde{u}^{\parallel}_{tot}(x,\omega)\right|^2 z_o} = \frac{\left[\left\{1-|\tilde{R}|^2\right\}+2i|\tilde{R}|\sin\left(2kx+\Delta\varphi^o_{BA}\right)\right]}{\left[\left\{1+|\tilde{R}|^2\right\}-2|\tilde{R}|\cos\left(2kx+\Delta\varphi^o_{BA}\right)\right]} = \frac{\tilde{z}^{\parallel}_{a_{tot}}(x,\omega)}{z_o} = \frac{\tilde{c}^{\parallel}_{a_{tot}}(x,\omega)}{c}$$