$$U = \begin{bmatrix} u_x \\ u_z \\ \varphi \end{bmatrix} \qquad V = \begin{bmatrix} v_x \\ v_z \\ \Omega \end{bmatrix} \qquad E_0 = \begin{bmatrix} -1 \\ 0 \\ -\kappa_0 \end{bmatrix} \qquad D = \begin{bmatrix} u_x' + \cos\varphi_0 \\ u_z' + \sin\varphi_0 \\ \varphi' \end{bmatrix}$$

$$R(\varphi) = \begin{bmatrix} \cos\varphi & \sin\varphi & 0 \\ -\sin\varphi & \cos\varphi & 0 \\ 0 & 0 & 1 \end{bmatrix} \qquad R^{(n)}(\varphi) = \begin{bmatrix} 0 & 1 & 0 \\ -1 & 0 & 0 \\ 0 & 0 & 0 \end{bmatrix}^n R(\varphi)$$

$$E = R(\varphi)D + E_0$$

$$\mathcal{R} = R(\varphi)CE$$

$$\mathcal{N} = CE$$

$$\delta E = \delta\varphi \; R^{(1)}(\varphi)D + R(\varphi)\; \delta D$$

$$\delta\mathcal{R} = \delta\varphi \; (R^{(1)}(\varphi)CE + R(\varphi)CR(1)(\varphi)D) + R(\varphi)CR(\varphi)\; \delta D$$

$$\delta\mathcal{N} = \delta\varphi \; CR(1)(\varphi)D + CR(\varphi)\; \delta D$$

$$\mathcal{F} = \int_0^l \mathcal{R}\mathcal{P}_i + (p - \rho\dot{V} + \begin{bmatrix} 0 \\ 0 \\ \mathcal{N}_1 E_2 - (1+E_1)\mathcal{N}_2 \end{bmatrix})\mathcal{P}_i \; dx + \mathcal{R}\mathcal{P}_i\Big|_0^l$$

$$\delta\mathcal{F} = \int_0^l \delta\mathcal{R}\mathcal{P}_i' + \begin{bmatrix} 0 \\ 0 \\ E_2\delta\mathcal{N}_1 + \delta E_2\mathcal{N}_1 - (1+E_1)\delta\mathcal{N}_2 - \delta E_1\mathcal{N}_2 \end{bmatrix}\mathcal{P}_i \; dx$$