Partant de l'équation **??** on annule les termes en ${\boldsymbol{\varphi_q}}^*$ et g^*, pour obtenir :

$$\begin{array}{lll} \forall h^* & \int_T\int_\Theta {\boldsymbol{\varphi_q}}^T g h^* & [\ \mathbf{K}\ \boldsymbol{\varphi_q} g h +\ \mathbf{C}\ \boldsymbol{\varphi_q}\dot{g}h +\ \mathbf{M}\ \boldsymbol{\varphi_q}\ddot{g}h \\ & & +\mathbf{K}\ \sum_{k=1}^{n-1}(\boldsymbol{\varphi_q})_k g_k h_k + \mathbf{C}\ \sum_{k=1}^{n-1}(\boldsymbol{\varphi_q})_k \dot{g}_k h_k \\ & & +\mathbf{M}\ \sum_{k=1}^{n-1}(\boldsymbol{\varphi_q})_k \ddot{g}_k h_k - \mathbf{f}\ ]\ dt d\theta \quad = 0 \end{array} \tag{1}$$

On sort h (indépendant de t) de l'integrale sur T :

$$\begin{array}{llll} \forall h^* & \int_\Theta h^* \int_T g {\boldsymbol{\varphi_q}}^T & [\ \mathbf{K}\ \boldsymbol{\varphi_q} g +\ \mathbf{C}\ \boldsymbol{\varphi_q}\dot{g} +\ \mathbf{M}\ \boldsymbol{\varphi_q}\ddot{g}]\ dt\ h\ d\theta \\ = & \int_\Theta h^* \int_T g {\boldsymbol{\varphi_q}}^T & -[\ \mathbf{K}\ \sum_{k=1}^{n-1}(\boldsymbol{\varphi_q})_k g_k h_k + \mathbf{C}\ \sum_{k=1}^{n-1}(\boldsymbol{\varphi_q})_k \dot{g}_k h_k \\ & & +\mathbf{M}\ \sum_{k=1}^{n-1}(\boldsymbol{\varphi_q})_k \ddot{g}_k h_k - \mathbf{f}\ ]\ dt d\theta \end{array} \tag{2}$$

Contrairement au problème précédant (en temps) on a une dépendance des termes intégrés par rapport à la variable θ. Pour continuer on fait donc apparaitre la forme discrétisée :

$$h(\theta) \quad = \quad \sum_{i=1}^{Nbc_\theta} N_{hi}(\theta) h_i \quad = \quad N_h(\theta)\boldsymbol{h_q} \tag{3}$$

Ce qui donne :

$$\begin{array}{llll} \forall {\boldsymbol{h_q}}^* & \int_\Theta {\boldsymbol{h_q}}^{*T} N_h(\theta)^T \int_T g {\boldsymbol{\varphi_q}}^T & [\mathbf{K}\boldsymbol{\varphi_q} g + \mathbf{C}\boldsymbol{\varphi_q}\dot{g} + \mathbf{M}\boldsymbol{\varphi_q}\ddot{g}]\, dt N_h(\theta)\boldsymbol{h_q} d\theta \\ = & \int_\Theta {\boldsymbol{h_q}}^{*T} N_h(\theta)^T \int_T g {\boldsymbol{\varphi_q}}^T & -[\ \mathbf{K}\ \sum_{k=1}^{n-1}(\boldsymbol{\varphi_q})_k g_k N_h(\theta)(\boldsymbol{h_q})_k \\ & & \quad +\ \mathbf{C}\ \sum_{k=1}^{n-1}(\boldsymbol{\varphi_q})_k \dot{g}_k N_h(\theta)(\boldsymbol{h_q})_k \\ & & \quad +\ \mathbf{M}\ \sum_{k=1}^{n-1}(\boldsymbol{\varphi_q})_k \ddot{g}_k N_h(\theta)(\boldsymbol{h_q})_k \\ & & \quad -\ \mathbf{f}\ ]\ dt d\theta \end{array} \tag{4}$$

Soit :

$$\begin{array}{lll} & \int_\Theta N_h(\theta)^T \int_T g {\boldsymbol{\varphi_q}}^T & [\mathbf{K}\boldsymbol{\varphi_q} g + \mathbf{C}\boldsymbol{\varphi_q}\dot{g} + \mathbf{M}\boldsymbol{\varphi_q}\ddot{g}]\, dt N_h(\theta)\boldsymbol{h_q} d\theta \\ = & \int_\Theta N_h(\theta)^T \int_T g {\boldsymbol{\varphi_q}}^T & -[\ \mathbf{K}\ \sum_{k=1}^{n-1}(\boldsymbol{\varphi_q})_k g_k N_h(\theta)(\boldsymbol{h_q})_k \\ & & \quad +\ \mathbf{C}\ \sum_{k=1}^{n-1}(\boldsymbol{\varphi_q})_k \dot{g}_k N_h(\theta)(\boldsymbol{h_q})_k \\ & & \quad +\ \mathbf{M}\ \sum_{k=1}^{n-1}(\boldsymbol{\varphi_q})_k \ddot{g}_k N_h(\theta)(\boldsymbol{h_q})_k \\ & & \quad -\ \mathbf{f}\ ]\ dt d\theta \end{array} \tag{5}$$

On sort l'inconnue $\boldsymbol{h_q}$ pour obtenir le système :

$$\begin{array}{lll} & \int_\Theta N_h(\theta)^T \int_T g {\boldsymbol{\varphi_q}}^T & [\mathbf{K}\boldsymbol{\varphi_q} g + \mathbf{C}\boldsymbol{\varphi_q}\dot{g} + \mathbf{M}\boldsymbol{\varphi_q}\ddot{g}]\, dt N_h(\theta) d\theta \boldsymbol{h_q} \\ = & \int_\Theta N_h(\theta)^T \int_T g {\boldsymbol{\varphi_q}}^T & -[\ \mathbf{K}\ \sum_{k=1}^{n-1}(\boldsymbol{\varphi_q})_k g_k N_h(\theta)(\boldsymbol{h_q})_k \\ & & \quad +\ \mathbf{C}\ \sum_{k=1}^{n-1}(\boldsymbol{\varphi_q})_k \dot{g}_k N_h(\theta)(\boldsymbol{h_q})_k \\ & & \quad +\ \mathbf{M}\ \sum_{k=1}^{n-1}(\boldsymbol{\varphi_q})_k \ddot{g}_k N_h(\theta)(\boldsymbol{h_q})_k \\ & & \quad -\ \mathbf{f}\ ]\ dt d\theta \end{array} \tag{6}$$

Et pour continuer les calculs il faudrait expliciter la dépendance des termes par rapport à θ.