$(1+\epsilon)ds$





$$m{M}_1(s+ds)$$

$$-oldsymbol{M}_1(s)$$

$$oldsymbol{M}_2(s+ds)$$

$$-oldsymbol{M}_2(s)$$

$$oldsymbol{M}(s+ds)$$

$$-oldsymbol{M}(s)$$

$$oldsymbol{N}(s+ds)$$



O









$$m{T}_1(s+ds)$$

$$-oldsymbol{T}_1(s)$$

$$oldsymbol{T}_2(s+ds)$$

$$-oldsymbol{T}_2(s)$$



 X_2

$arc\ tangent$

$beam\ tangent$



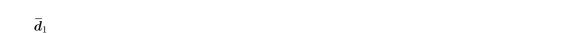


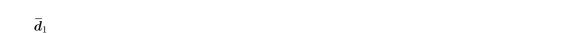














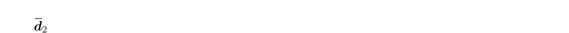
















$$d\theta = \kappa ds$$

$$d\theta_1 = \kappa_1 ds$$

$$d\theta_2 = \kappa_2 ds$$

$$d\theta_3 = \tau ds$$































fiber



ghost

handle

$$\kappa_1 oldsymbol{d}_1$$

$$\kappa_2 oldsymbol{d}_2$$

 κ_0

$$\kappa_1$$

 κ_2

 κ_3

$$\kappa_{i+1}$$

 κ_{i-1}

 κ_i

$$\kappa_{n-1}$$

 κ_{n-2}

$$\kappa_n$$

 κb

$$oldsymbol{\kappa}oldsymbol{b}_0$$

$$oldsymbol{\kappa}oldsymbol{b}_1$$

 $oldsymbol{\kappa} oldsymbol{b}_{2i+1}$

$$\kappa b_{2i-1}$$

$$\kappa b_{2i}^+$$

$$\kappa b_{2i}^-$$

 $\boldsymbol{\kappa}\boldsymbol{b}_{i+1}$

 $oldsymbol{\kappa} oldsymbol{b}_{i-1}$

 $oldsymbol{\kappa} oldsymbol{b}_i$

 $oldsymbol{\kappa} oldsymbol{b}_{n-1}$

$$\kappa b_{n-2}$$





 \varkappa_2

 $\overline{\varkappa}_2$

 \varkappa_3

 $\bar{\varkappa}_3$

$\bar{\varkappa}_3 ds$

 $\varkappa_3 ds$





$$oldsymbol{p} = oldsymbol{x} + X_{lpha} oldsymbol{d}_{lpha} + u_k oldsymbol{d}_k$$



$$arphi_0^+$$

$$arphi_1$$

$$arphi_{i+1}$$

$$arphi_{i-1}$$

$$arphi_i^+$$

$$arphi_i^-$$

 φ_i



 φ_{n-1}

$$arphi_n^-$$

$$arphi_n$$



$$oldsymbol{r} = X_{lpha} oldsymbol{d}_{lpha} + oldsymbol{u}_k oldsymbol{d}_k$$



$$oldsymbol{ar{r}} = X_{lpha} oldsymbol{ar{d}}_{lpha}$$

s + ds

s-ds





 s_{i+1}

 s_{i-1}







$$s_t + (1 + \epsilon)ds$$

$$s_t - (1 + \epsilon)ds$$

S_{t}











$$t_{2i}^+$$















 \boldsymbol{u}_{2i}



 u_i





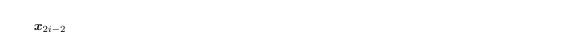


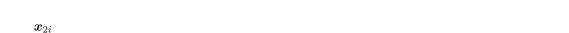
 $oldsymbol{x}_2$





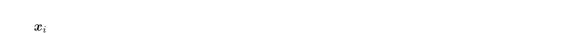






 $oldsymbol{x}_{i+1}$

$$oldsymbol{x}_{i-1}$$



$$x_{n-1}$$







$$\tilde{x}_i^+$$

$$ilde{x}_i^-$$





