direction.

In the present study, the Golden section method is employed for determining the step-length, which requires the scalar l_k satisfy

$$f(z_{k+1}) = \min\left\{f\left(z_k + l\theta_{k+1}\big|_{l\geq 0}\right)\right\} \tag{12}$$

The algorithm for the minimization of the function $f(z_k)$ is considered to have converged when the successive evaluations are such that $\|f(z)\| \leq \varepsilon$, where ε is a prescribed tolerance.

Moreover, the gradient of the objective function $f(z)$ in equations (10) may be written as :

$$\frac{\partial f(z)}{\partial z} = 2\sum_{i=1}^{I} \phi_i \frac{\lambda_i(z) - \bar{\lambda}_i}{\bar{\lambda}_i^{\,2}} \frac{\partial \lambda_i}{\partial z} \tag{13}$$

where $\partial\lambda_i / \partial z$ are the natural frequency sensitivities that can be conveniently obtained from the boundary element formulation by using the implicit-differentiation approach in the Reference(Saigal *et al.*, 1989). An important feature of these derivations is that they do not require the computation of the inverse with respect to the Hessian matrix of the objective function.

5. Numerical examples

Two examples, respectively associated with the plate structures and the pavement-subgrade system, are presented to demonstrate the effectiveness of the formulations developed in this paper. All of these problems are concerned with the rectangular plates, which are assumed to have symmetric elastic restraints respectively along one pair of opposite edges Γ_1 and other pair of opposite edges Γ_2 as follows

$$\left.\begin{aligned} W_i &= \alpha_i\, Q_i \\ \Theta_i &= \beta_i\, M_i \end{aligned}\right\} \quad \text{on } \Gamma_i\,(\,i{=}1,\,2\,) \tag{14}$$

where α_i and β_i are the identified parameters.

5. 1. Identifying the boundary conditions of square plates (without foundation)

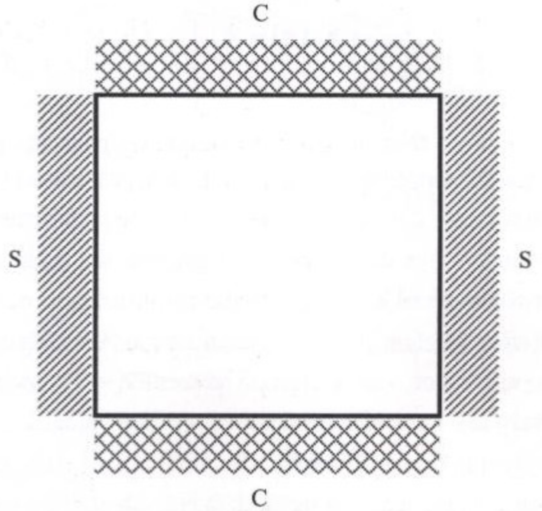
In this case, the square plates are simply supported along one pair of opposite edges Γ_2 . On the other pair of opposite edges Γ_1 , it has symmetric elastic restraints as equations (14). Poisson's ratio is chosen to be 0.3. Sixteen linear boundary elements in same size are employed for the computation. The actual boundary conditions(Fig.2) are given in following two cases:

(a). S-C-S-C boundary conditions:

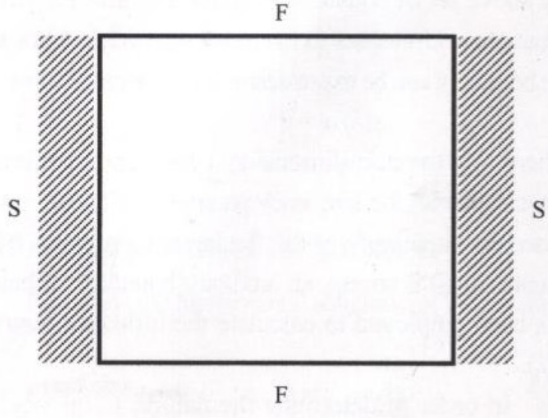
$$\begin{cases} \alpha_1{=}0 & \beta_1{=}0 \\ \alpha_2{=}0 & \beta_2{=}\infty \end{cases} \tag{15}$$

(b). S-F-S-F boundary conditions:

$$\begin{cases} \alpha_1{=}\infty & \beta_1{=}\infty \\ \alpha_2{=}0 & \beta_2{=}\infty \end{cases} \tag{16}$$



(a) S-C-S-C boundary conditions



(b) S-F-S-F boundary conditions

Fig. 2. Two kind of the actual boundary conditions.