

A Optimização na Engenharia Civil

Tertúlias de Engenharia Civil

Ordem dos Engenheiros

Norte

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Optimização

Determinação,
no estudo dum problema,
da **solução** que,
de entre **todas**
as soluções **possíveis**,
conduza aos resultados
mais
satisfatórios

Dicionário da Língua Portuguesa,
Porto Editora, 1994, pg 1304

Processo

Variáveis

Função Objectivo

Restrições

Dados

$X_1, X_2, X_3, \dots, X_n$

Minimizar $F(\underline{X})$

sujeito a

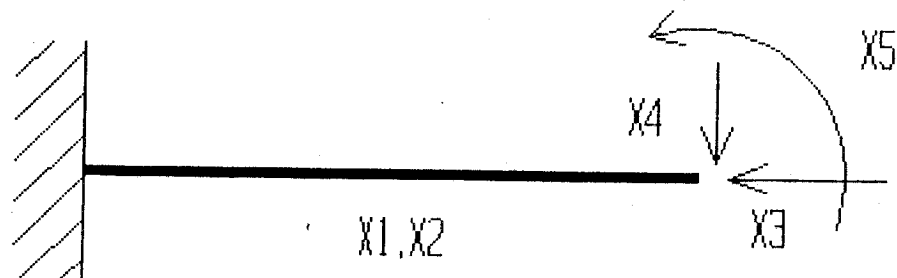
$G_1(\underline{X}) \leq 0$

$G_2(\underline{X}) \leq 0$

$G_3(\underline{X}) \leq 0$

.....

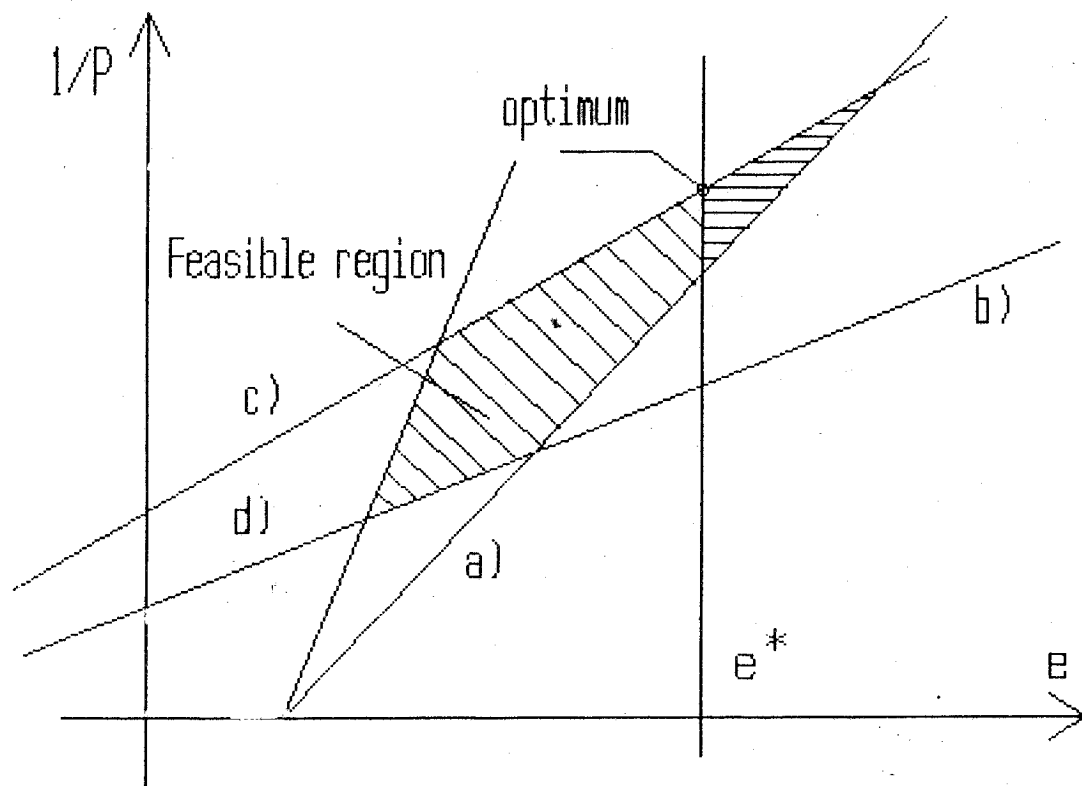
$G_n(\underline{X}) \leq 0$



- X1 - area of beam
- X2 - inertia of beam
- X3 - horizontal tip displacement
- X4 - vertical tip displacement
- X5 - tip rotation

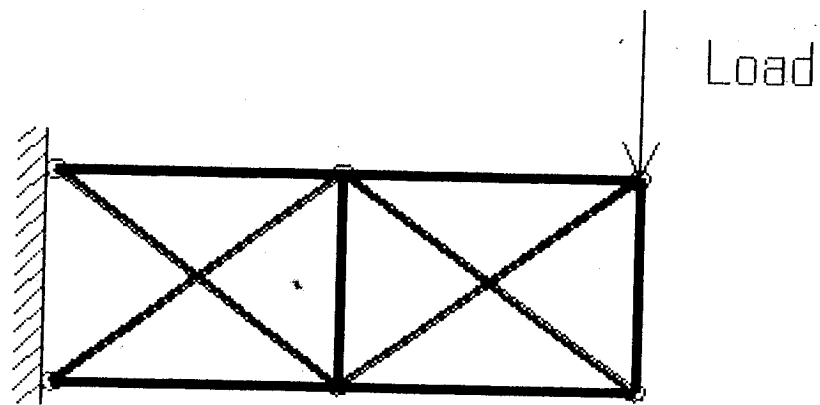
VARIABLE	INITIAL	FINAL
X1 (in ²)	1.0	6.65
X2 (in ⁴)	1.0	78625
X3 (in)	0.4	0.500
X4 (in)	0.4	0.353
X5 (rad)	0.4	0.006

Magnel's Diagram Optimum Pair P-e

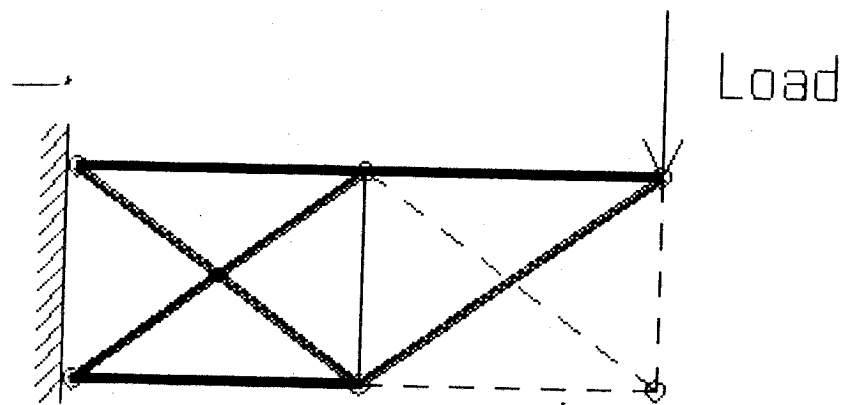


P - Initial prestressing force
 e - Eccentricity of cable
 e^* - maximum cable eccentricity
 $a), b)$ - minimum $1/P$
 $c), d)$ - maximum $1/P$

OPTIMIZATION OF TRUSS GEOMETRY



Initial Configuration

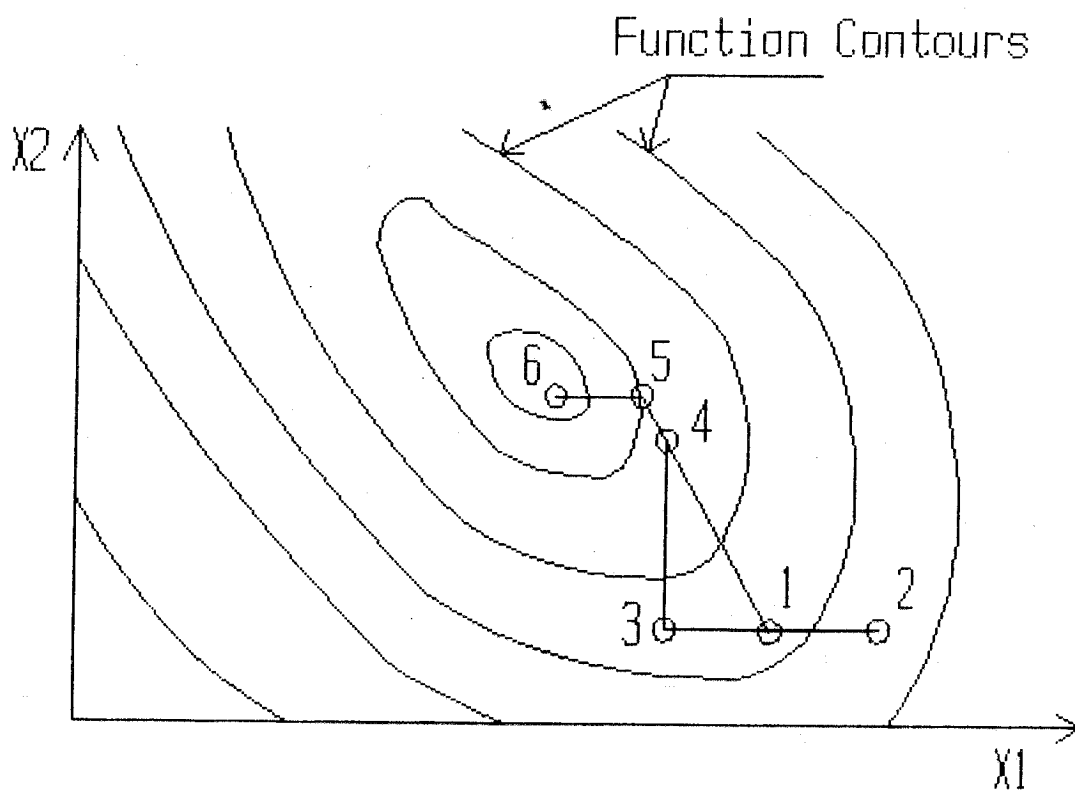


Optimal Configuration

HOOKE and JEEVES

1-Initial Point
6-Final Point

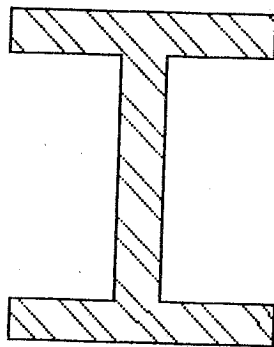
4/5 - Pattern Move



STEEL SECTION

DESIGN VARIABLES

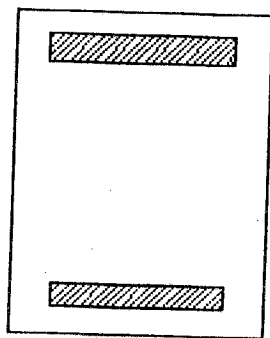
Flange width
Flange thickness
Web height
Web thickness



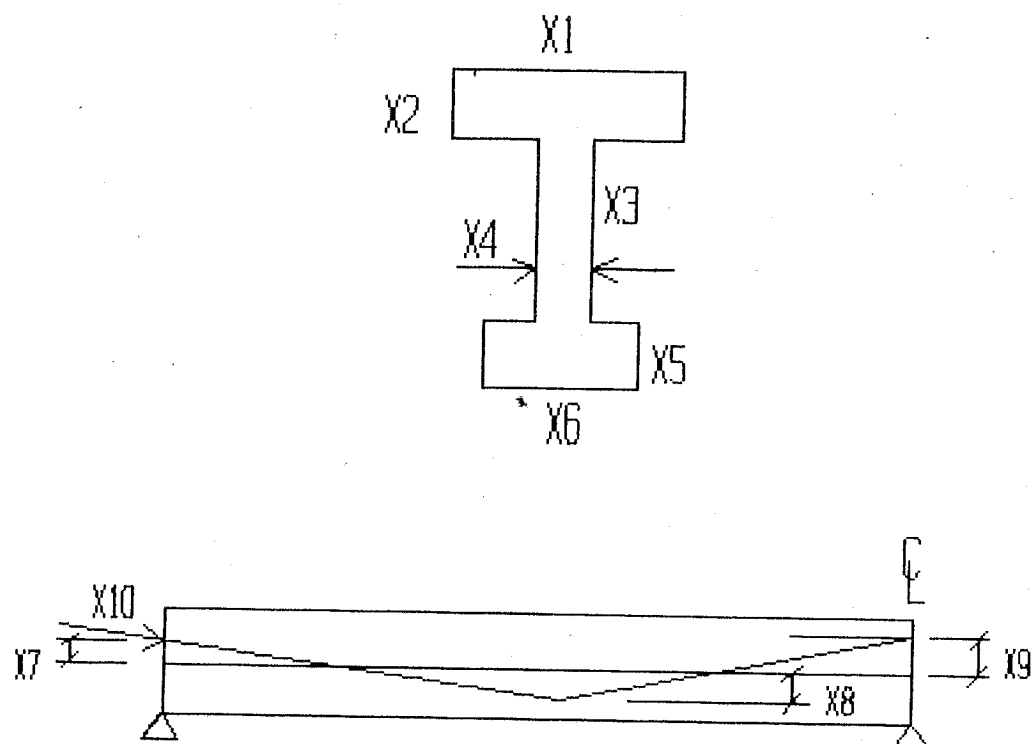
CONCRETE SECTION

DESIGN VARIABLES

Width
Height
Top reinforcement
Bottom reinforcement



Optimization of a Two span prestressed beam



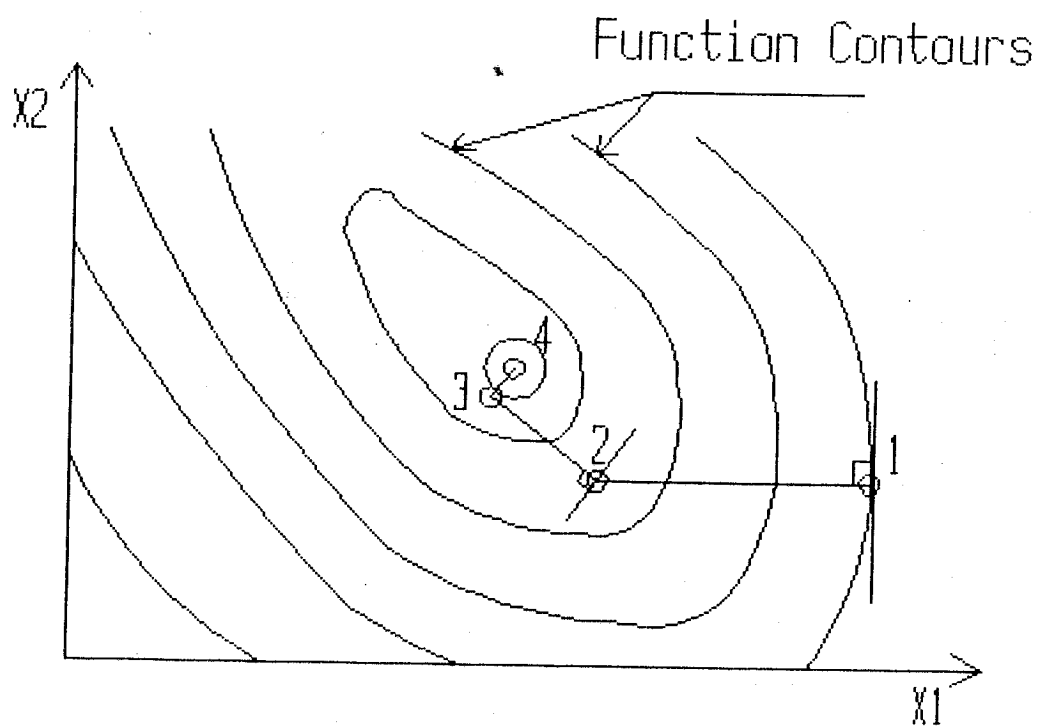
X1 to X6 - Section geometry

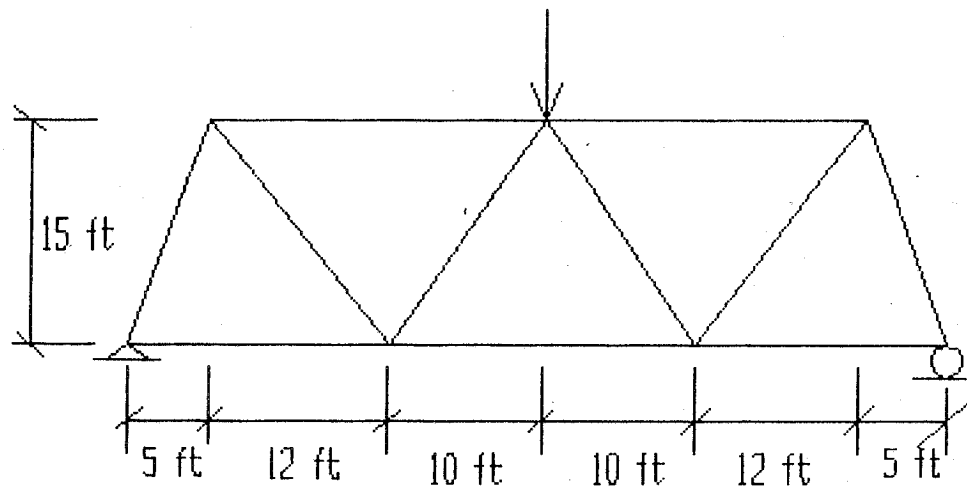
X7 to X9 - Eccentricities of draped cable

X10 - Prestressing force

STEEPEST DESCENT

1-Initial Point
4-Final Point





Minimize $\sum L_i A_i$
 subject to

$$F_i < F_c$$

$$F_i < F_t$$

where

L_i - length of truss bar i

A_i - area of truss bar i

F_i - stress in truss bar i

F_c - allowable compressive stress

F_t - allowable tensile stress