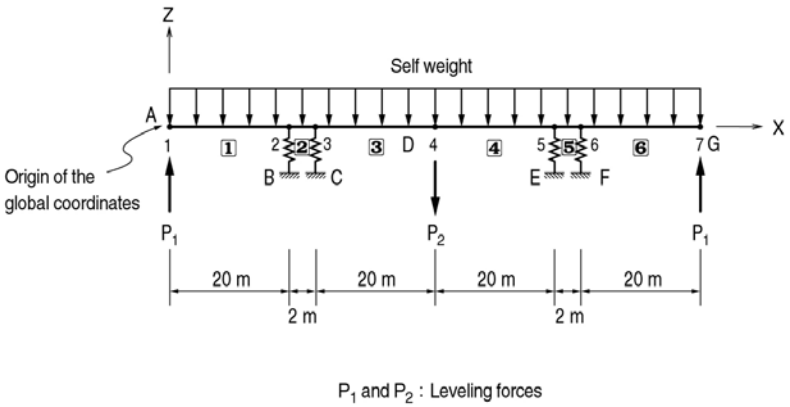
LFO-2

Title

Long span beam with leveling forces

Description

Determine the leveling forces P1 and P2 in order to induce the identical reaction at the supports B, C, E and F and the identical vertical displacement at the nodes A, D and G. This long span beam is subjected to its own weight only. Refer to the figure shown below.



Structural geometry and analysis model

Model

Analysis Type

2-D static analysis

Unit System

mm, kgf

Dimension

Length 84000 mm

Element

Beam element

Material

Steel	Modulus of elasticity	$E = 2.1 \times 10^4$ kgf/mm^2
	Poisson's ratio	$\nu = 0.3$
	Weight density	$\gamma = 7.85 \times 10^{-6}$ kgf/mm^3

Section Property

Box $300 \times 200 \times 10/15$ mm

Boundary Condition

Elastic boundary conditions ($K = 1 \times 10^6$ kgf/mm) are assigned at the nodes 2, 3, 5 and 6.

Load Case

A unit tension loads are applied at each leveling point.

Load Case 1 ; Load 1.0 is applied to the nodes 1 and 7 in the Z direction.

Load Case 2 ; Load 1.0 is applied to the node 4 in the -Z direction.

Load Case 3 ; Self weight is applied in the -Z direction.

Composition of Equations

Constitute equations in order to load combination factors.

The number of unknown load combination factors and required limitations should be equal.

Limitation ; The vertical displacement at the nodes 7 and 4 are indentical.

The reaction force at the nodes 2 and 3 are indentical.

Results

Load Combination Factors

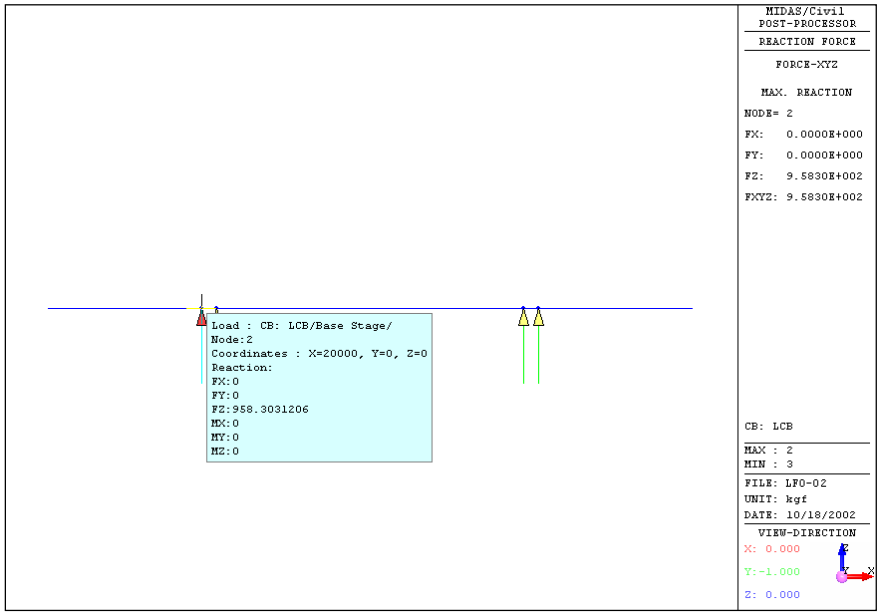
```
[ Unknown Load Factor Item : UNK ]
-------------------------------------------------------------------------------

 Selected Load Combination : LCB

     LCase         LCase Factor   Weighted Factor
--------------- --------------- -----------------
        CASE1        Unknown           1.000
        CASE2        Unknown           1.000
        CASE3          1.000

Object Function Type : Linear Absolute Sum
Sign of Unknown Factors : Both



---------------- Constraints ----------------

Constraint  DISP 1=4  : The Displacement,DZ of Node 1  =  That of Node 4
Constraint  REACT 2=3  : The Reaction,DZ of Node 2  =  That of Node 3


 The determined load factors by above constraints
-----------------------------------------------------
     LCase              LCase Factor
--------------- ------------------------
        CASE1        475.89196777344
        CASE2        -951.78381347656
-----------------------------------------------------
 Object Function Value = 1427.67578125
```

Combined Displacements

	Node	Load	DX (mm)	DY (mm)	DZ (mm)	RX ([rad])	RY ([rad])	RZ ([rad])
▶	1	LCB	0.000000	0.000000	-61.857831	0.000000	0.000000	0.000000
	2	LCB	0.000000	0.000000	-0.000958	0.000000	-0.001417	0.000000
	3	LCB	0.000000	0.000000	-0.000958	0.000000	0.001417	0.000000
	4	LCB	0.000000	0.000000	-61.857837	0.000000	0.000000	0.000000
	5	LCB	0.000000	0.000000	-0.000958	0.000000	-0.001417	0.000000
	6	LCB	0.000000	0.000000	-0.000958	0.000000	0.001417	0.000000
	7	LCB	0.000000	0.000000	-61.857831	0.000000	-0.000000	0.000000

Combined Reaction Forces

	Node	Load	FX (kgf)	FY (kgf)	FZ (kgf)	MX (kgf·mm)	MY (kgf·mm)	MZ (kgf·mm)
▶	2	LCB	0.000	0.000	958.303	0.000	0.000	0.000
	3	LCB	0.000	0.000	958.303	0.000	0.000	0.000
	5	LCB	0.000	0.000	958.303	0.000	0.000	0.000
	6	LCB	0.000	0.000	958.303	0.000	0.000	0.000
	SUMMATION OF REACTION FORCES PRINTOUT							
		Load	FX (kgf)	FY (kgf)	FZ (kgf)			
		LCB	0.000	0.000	3833.212			



Combined Reaction Forces

Results of MIDAS/Civil

Unit : mm, kgf

Load Case	Load combination factor	Limitation	Results after combination
1	475.89198	Vertical displacement at the nodes 1 and 4	-61.85783
2	-951.78381	Reaction at the nodes 2 and 3	958.303