[File upload] <u>ftp://cdl.hanyang.ac.kr</u> → cdl/cdl → 실습 → 실습\_mid\_term\_exam [analysis\_result\_file] (학번)\_(요소종류: beam/shell/solid)\_(요소수)\_(하중종류) [report\_file] (학번) upload only one file for two problems.

1. A curved beam structure under tip loads in two different directions. Fixed boundary condition is assigned to the root of the beam. A unit load is applied at the free end in two loadcases.



(1) Create the finite element model as follows and find the displacement at point A in each loadcase.

- ① Three beam elements (15 pts)
- ② Shell elements (three divisions in the tangential direction and one division in the radial direction) (15 pts)
- ③ Solid elements (same as shell elements with one layer in the thickness direction) (15 pts)

(2) Increase the number of divisions twice and three times, and repeat the problem (1). Graph the displacement versus the number of elements and make a discussion. (10 pts each)



2. Consider a plane frame structure with two vertical point forces.

(1) Find the buckling load and the mode shape using six beam elements (two elements in each side) as shown in the figure. (15 pts)

(2) Find the converged buckling load by increasing the number of elements (three and four elements in each side). Graph the result and make a discussion. (10 pts)