

Lateral Impacts to PC Girders in Bridges with Intermediate Diaphragms

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Sponsored by Iowa Highway Research Board

Background

- **Over-height vehicle impact frequency**
- **Intermediate diaphragm policies**
- **Bridge contractor preferences**
- **Previous research efforts**

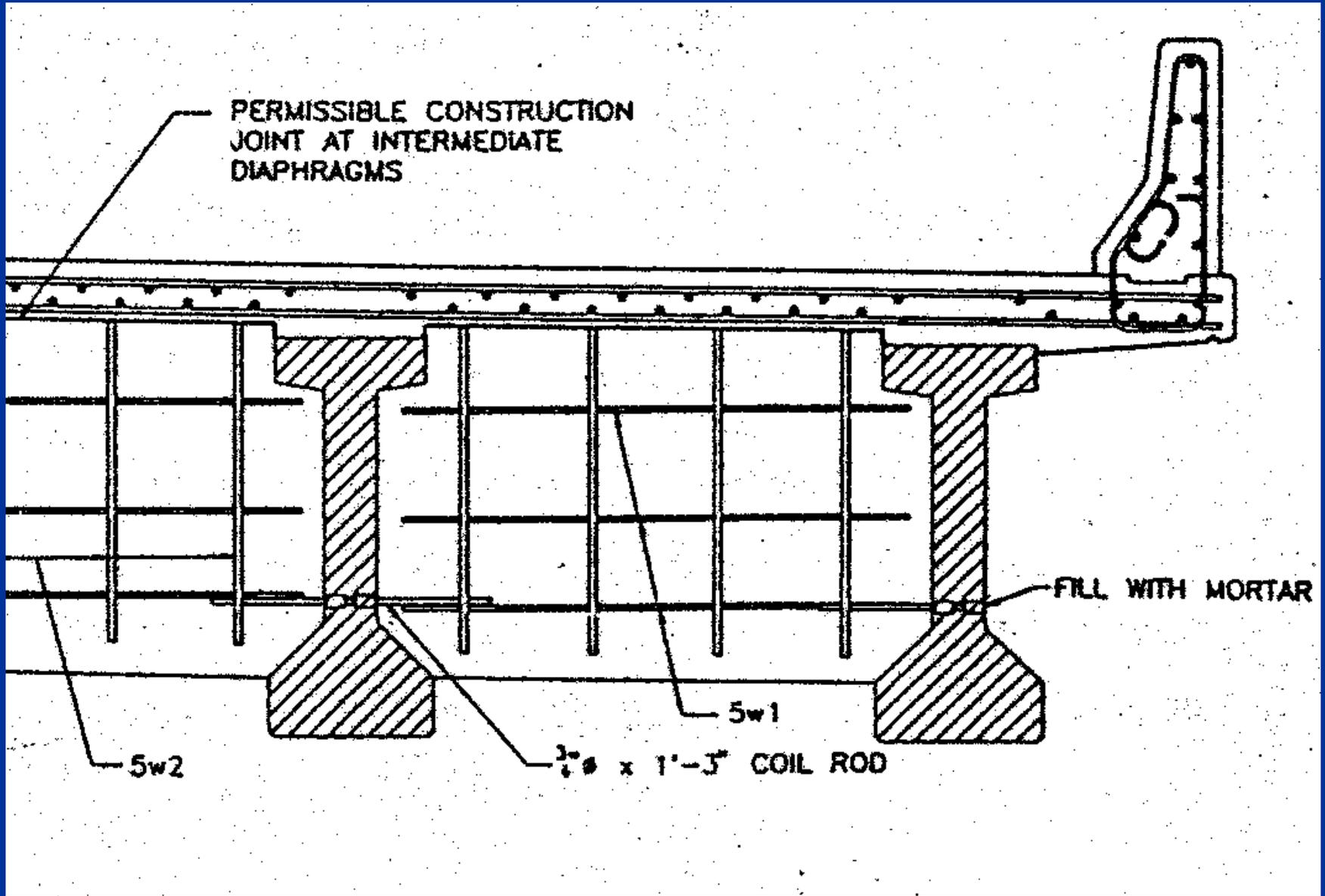
Objectives

To evaluate the effectiveness of intermediate diaphragms for prestressed concrete (PC) girder bridges in distributing lateral loads that assimilate the effects of an over-height-vehicle load striking the bottom flange of an exterior girder.

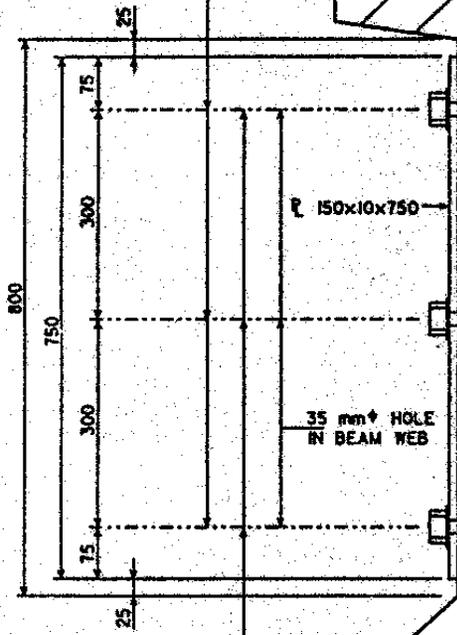
Bridge Geometrical Characteristics

- **Prototype Bridges**
- **Spans**
- **Girders**
- **Horizontal Alignment**

Intermediate Diaphragm Types



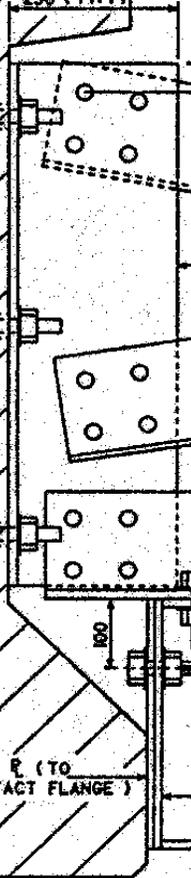
19 mm ϕ H.S. BOLT WITH HEX NUT AND 2 HARDENED WASHERS



\square 150x10x750

24 mm ϕ HOLE IN ISO LEG OF BENT \square AND IN \square 150x10x750

230 (TYP.)



BENT \square 230x150x12x750

21 mm x 25 mm SHORT SLOTTED HOLES LONGITUDINALLY IN ANGLES FOR 19 mm ϕ BOLT WITH TWO WASHERS, HEX. NUT AND 14 mm FILL PLATE.

L 152x102X7.9

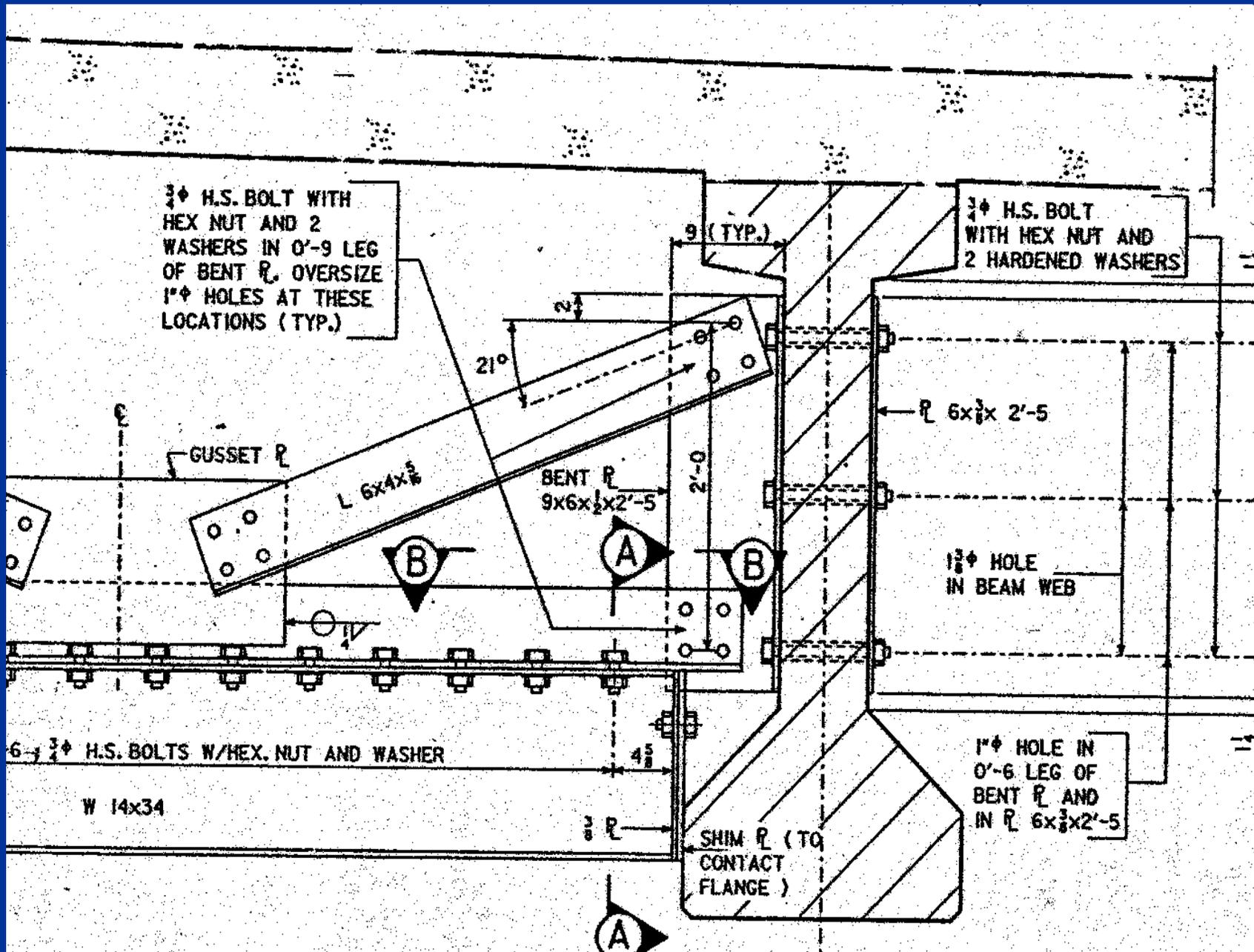
18°50'

WT 155x26

100

14 SPA. @ 150 = 2100 ; 19 mm ϕ H.S. BOLTS W/

W 360x51



Analytical Approach

- **Finite-element analysis**
- **Calibration**
 - **Experimental bridge**
 - **FE analysis**
 - **Comparison of results**

Analysis of Prototype Bridges

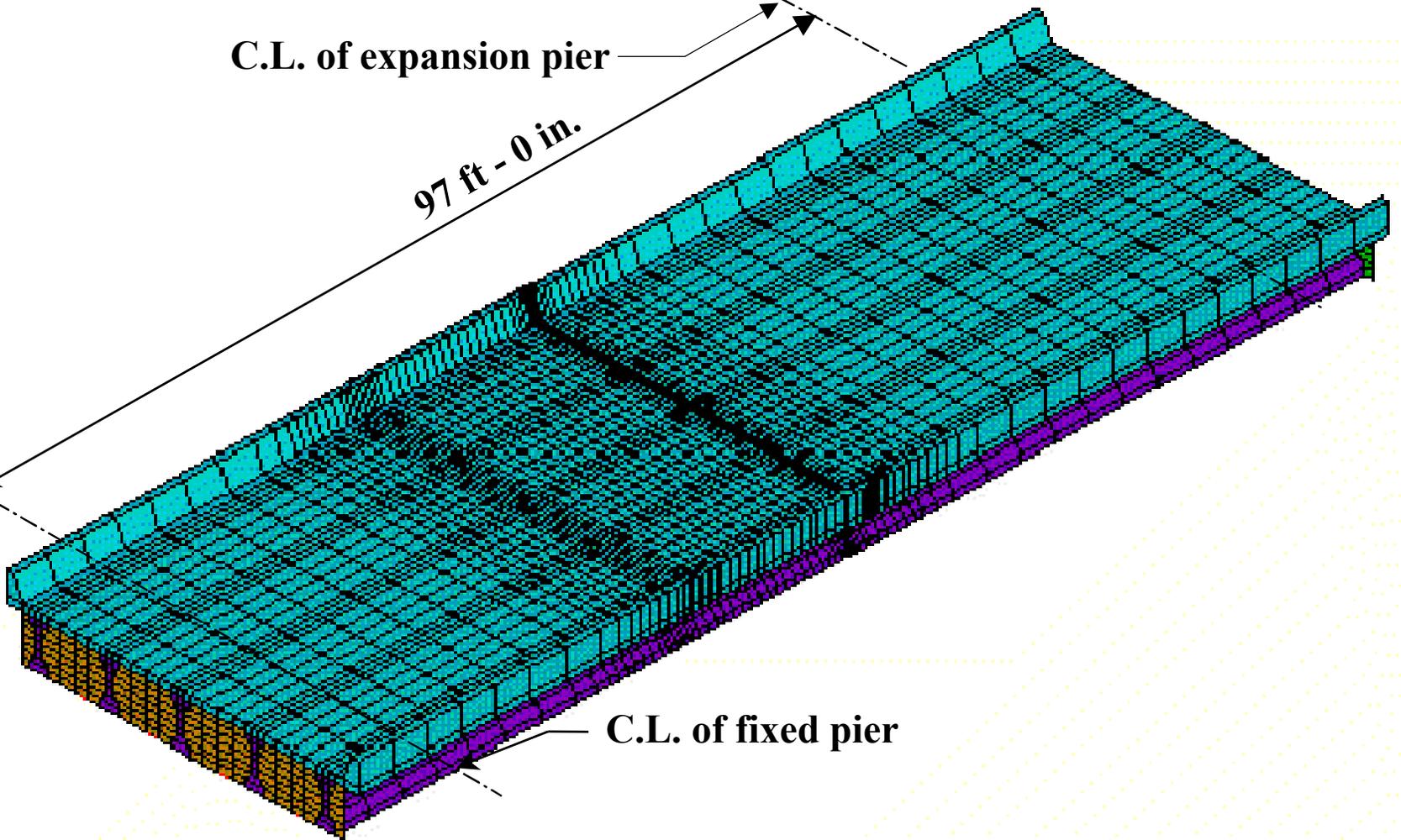
Four-span bridge model

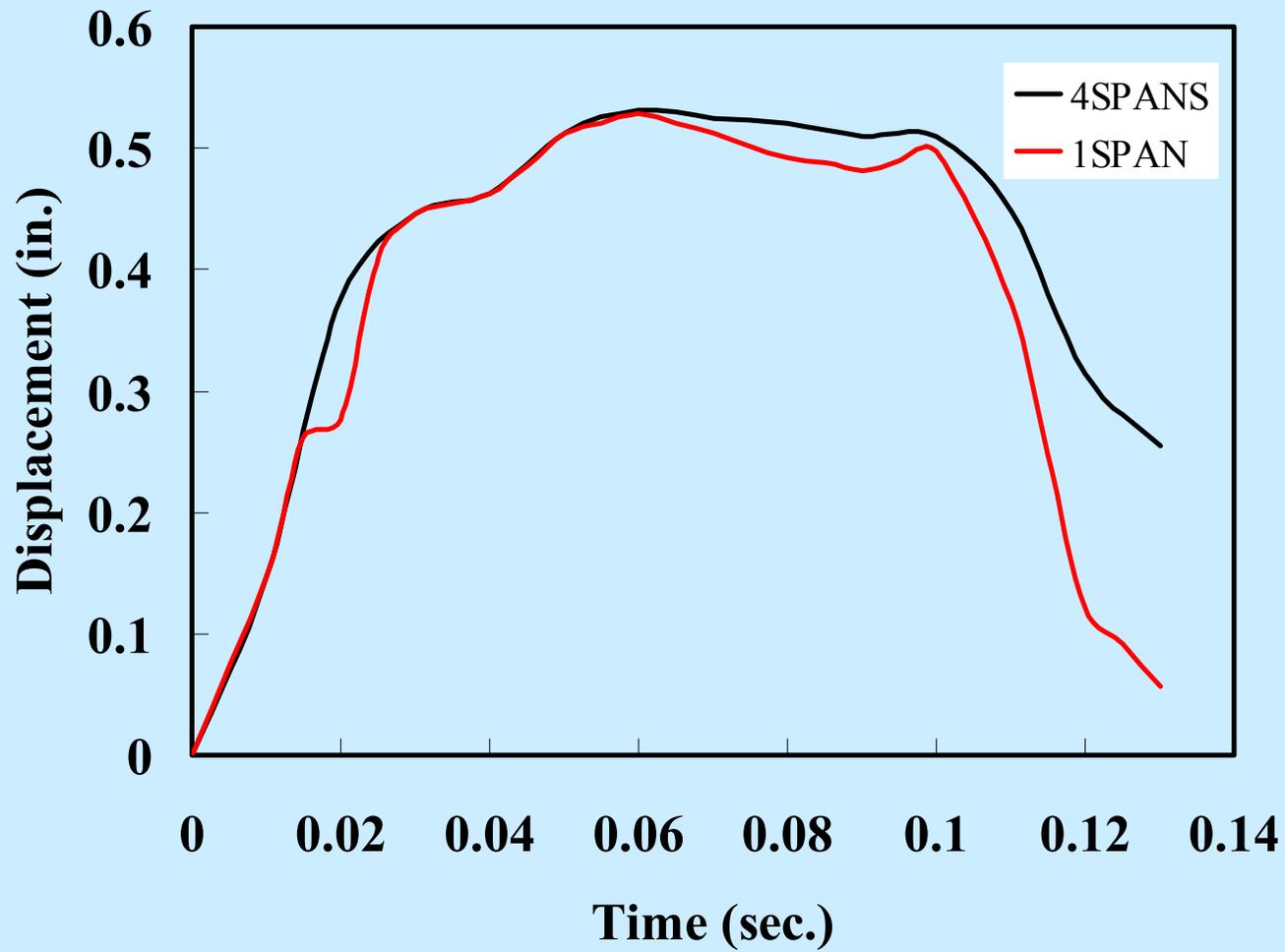
One-span bridge model

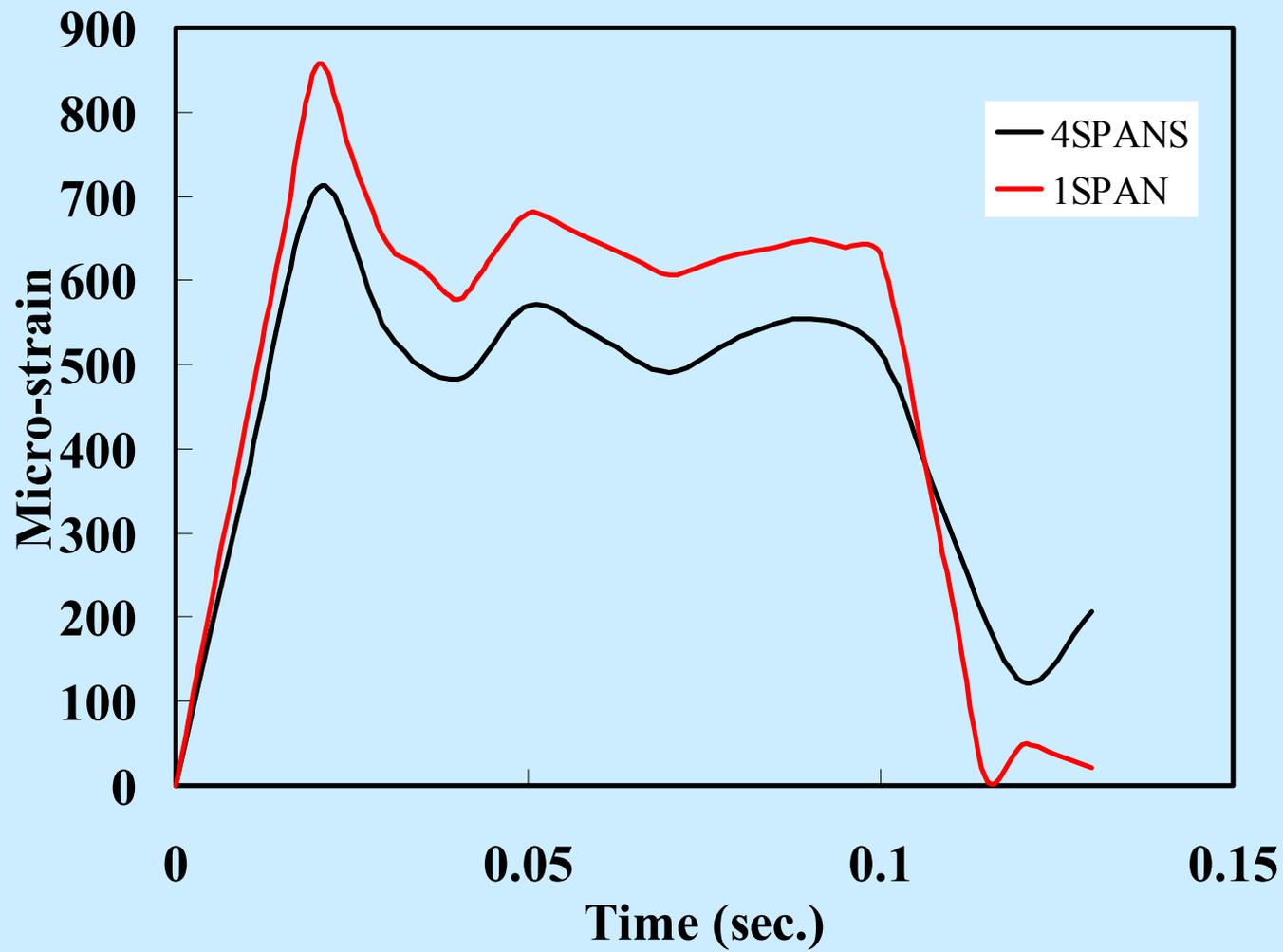
C.L. of expansion pier

97 ft - 0 in.

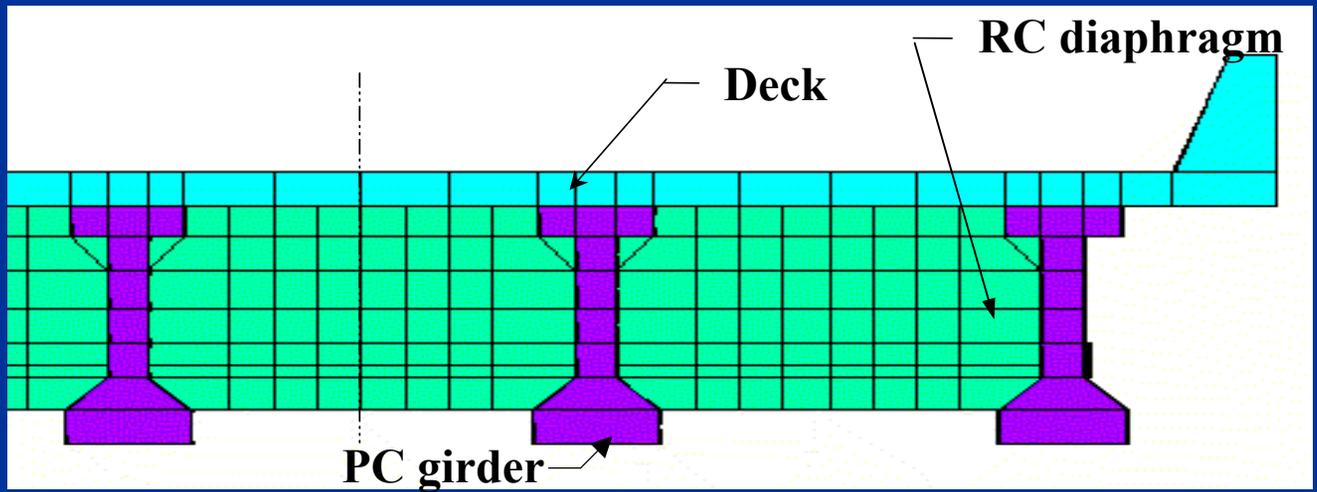
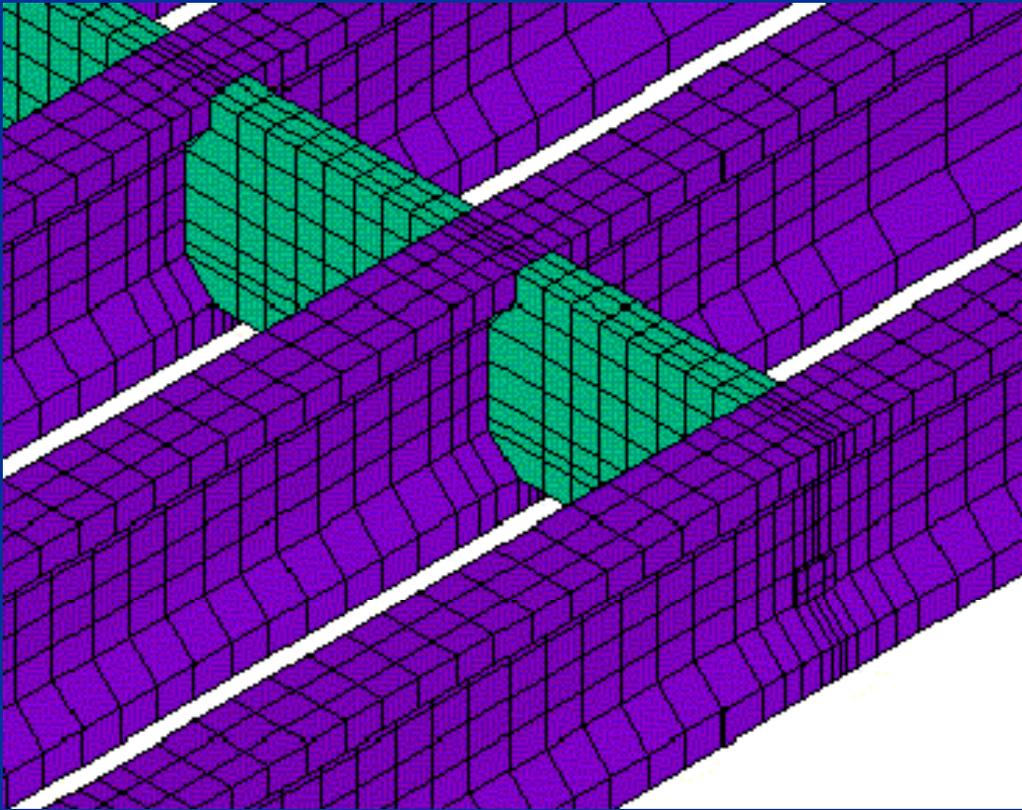
C.L. of fixed pier

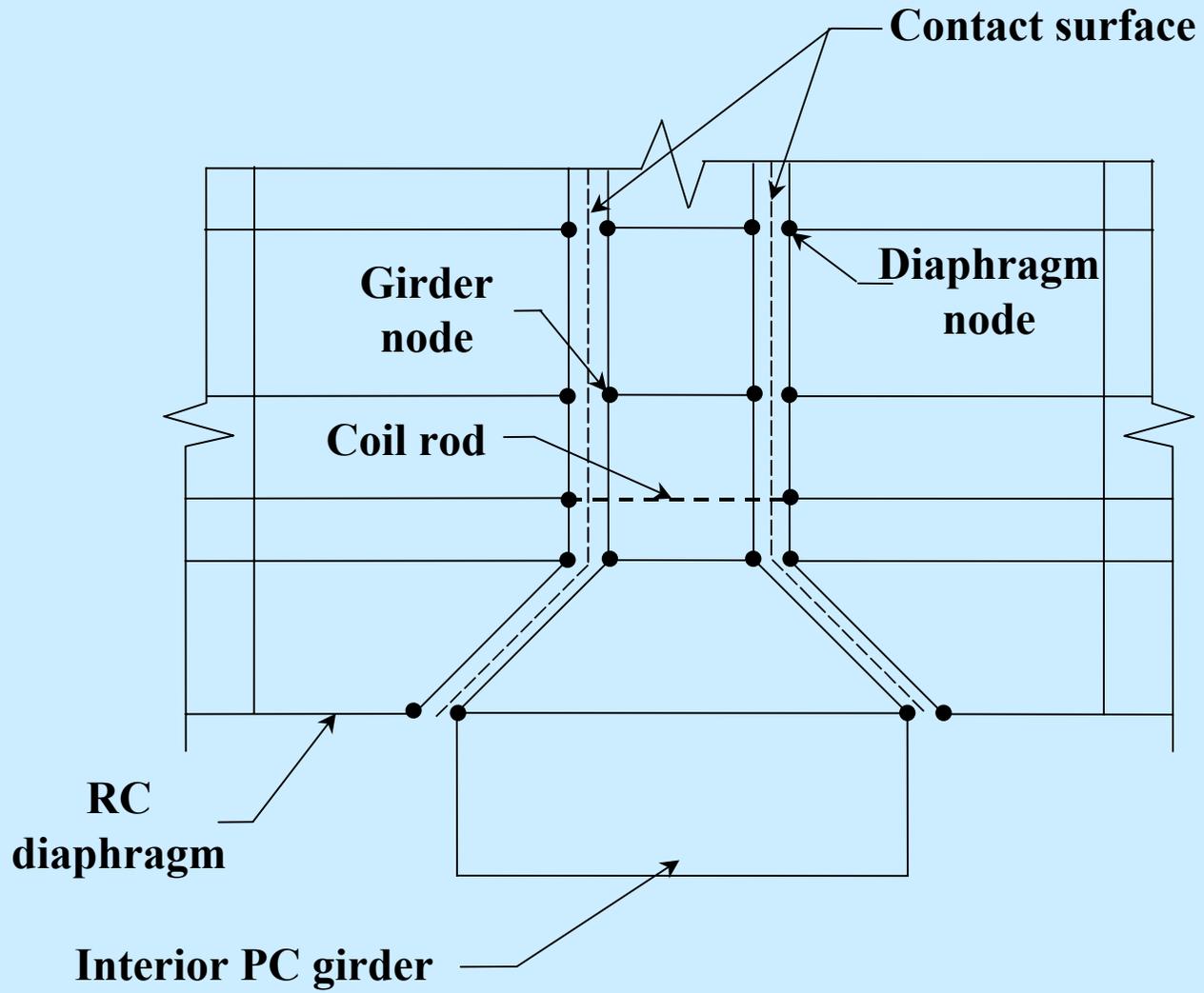


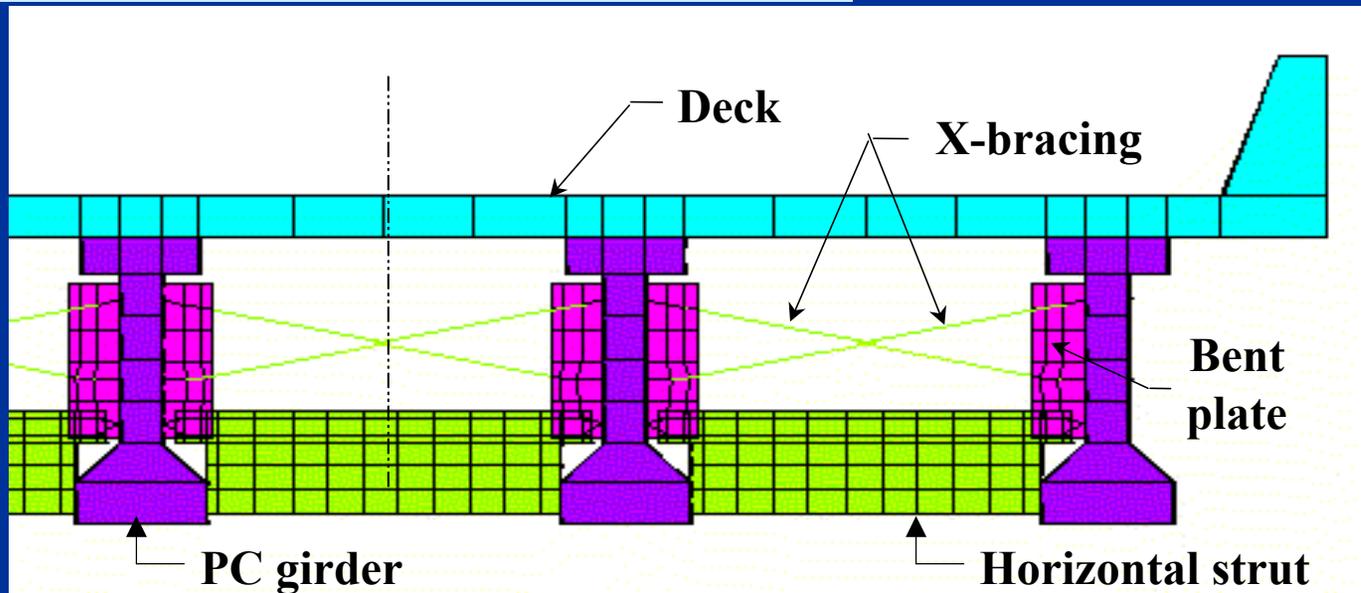
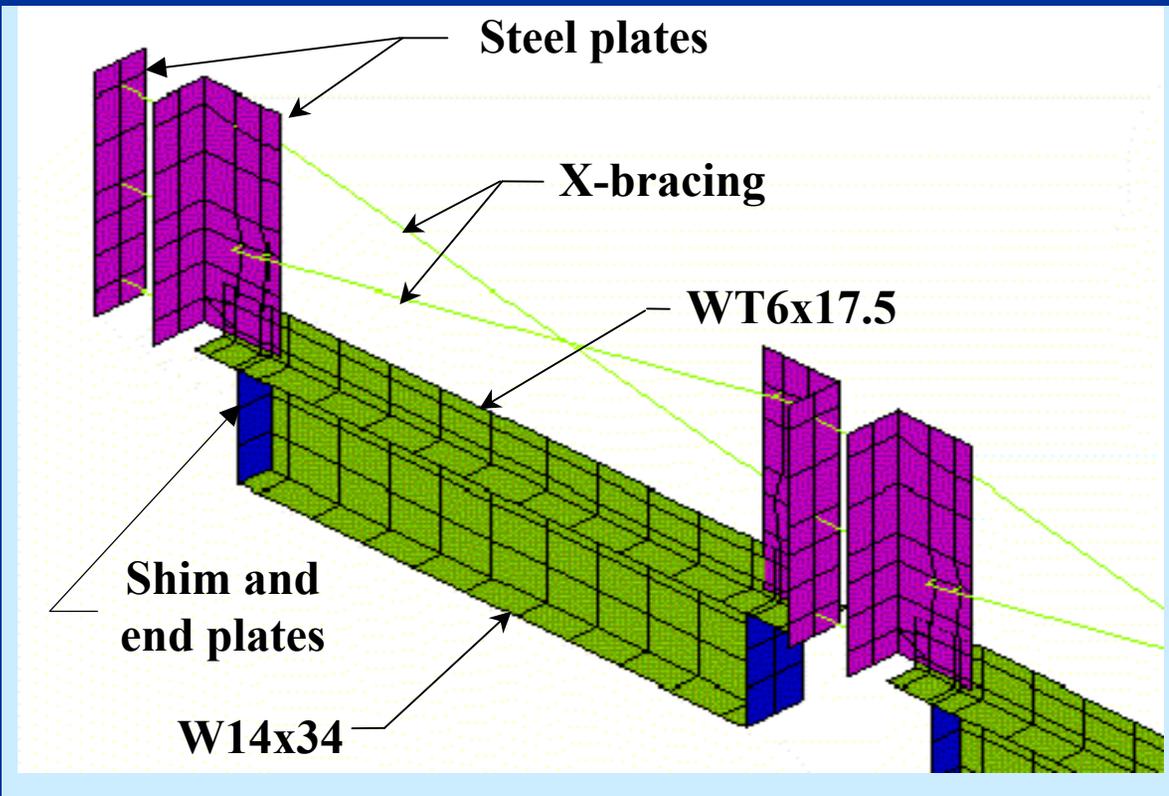


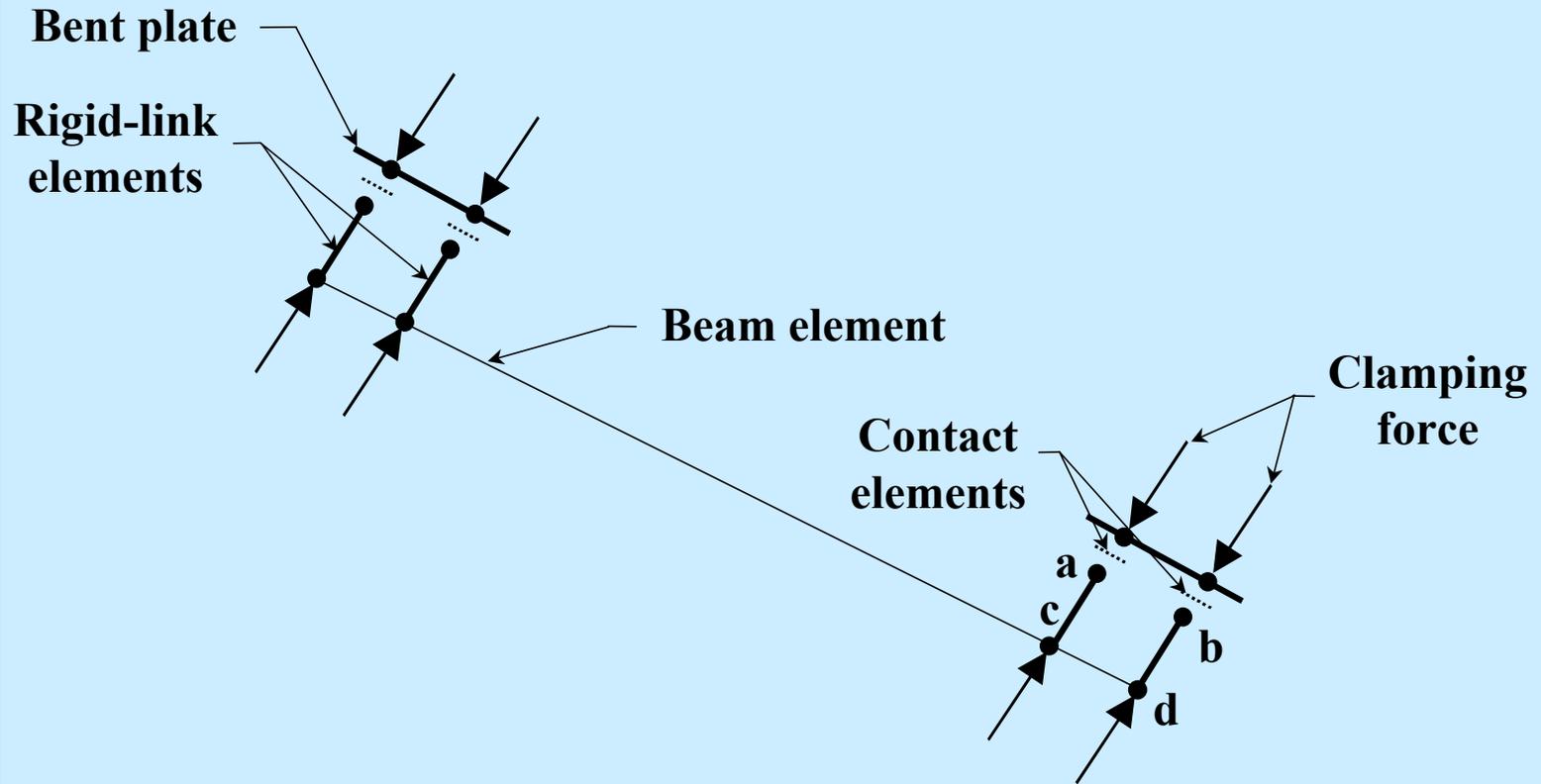


Intermediate Diaphragm Models

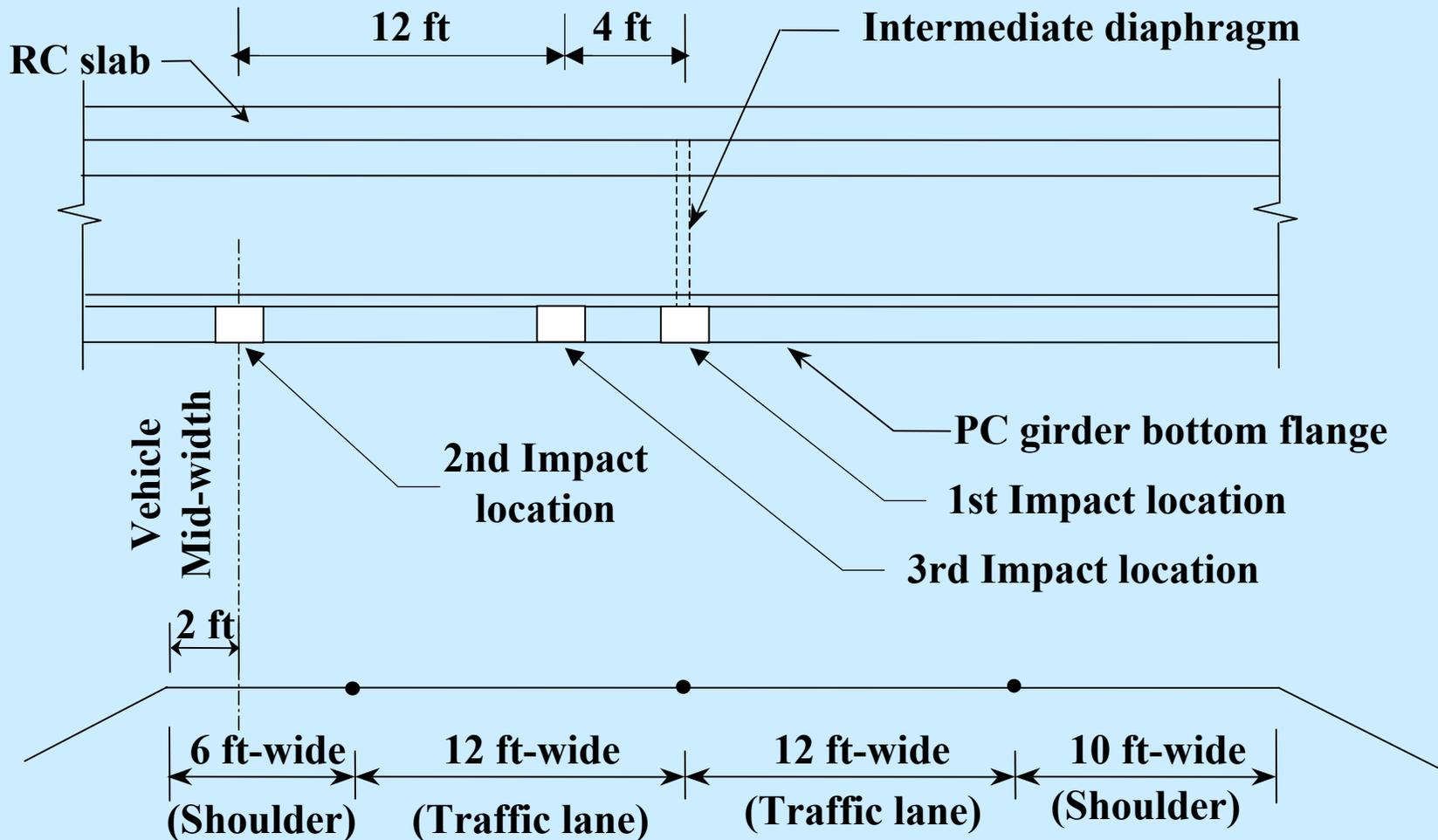




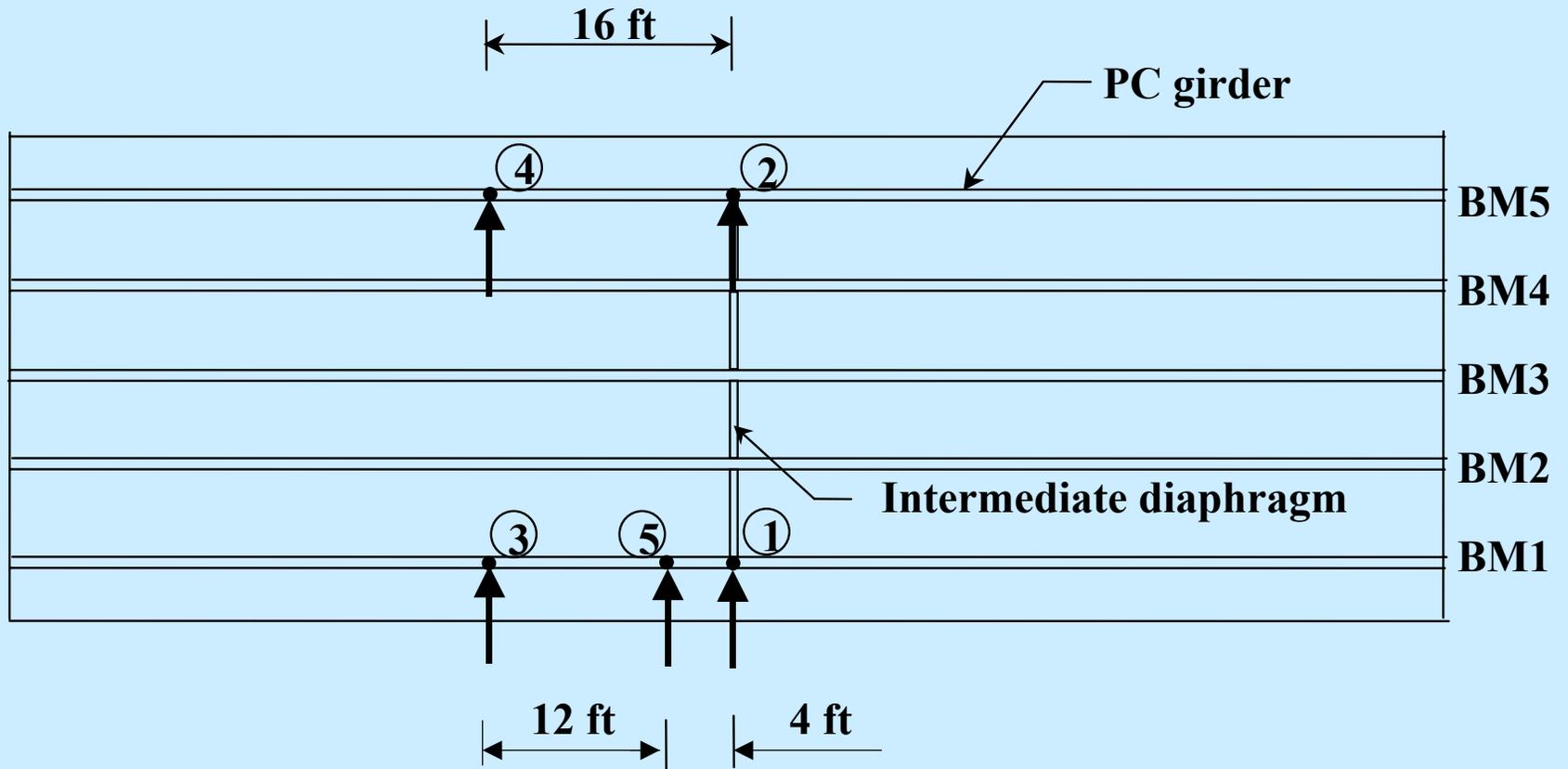




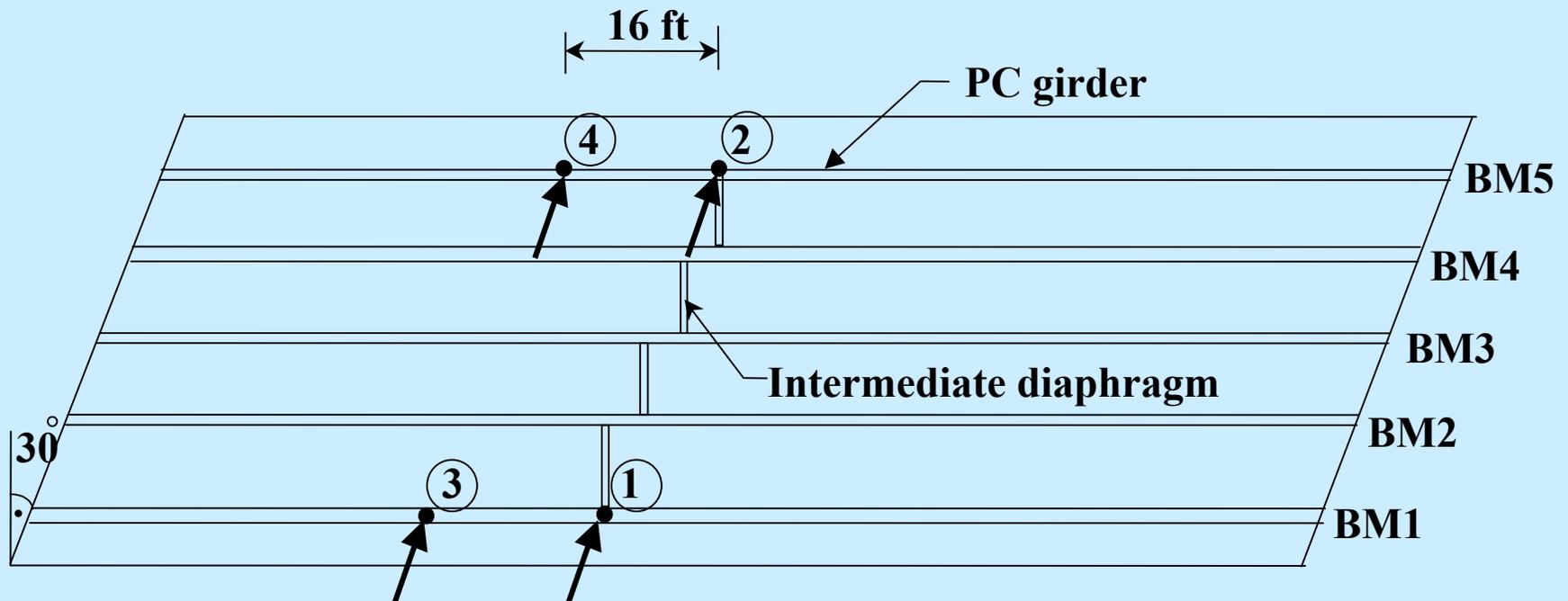
Load Points



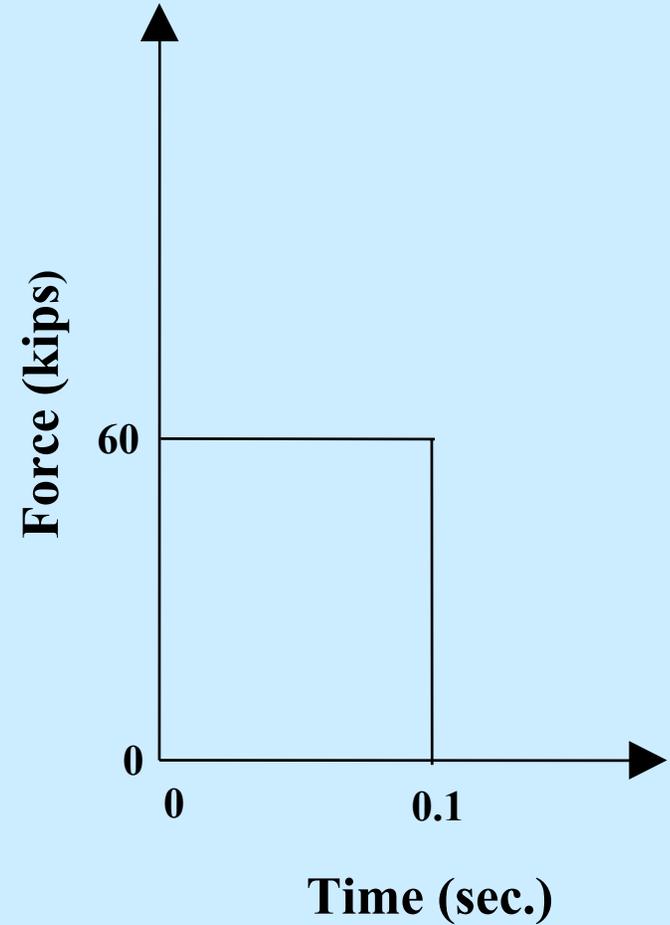
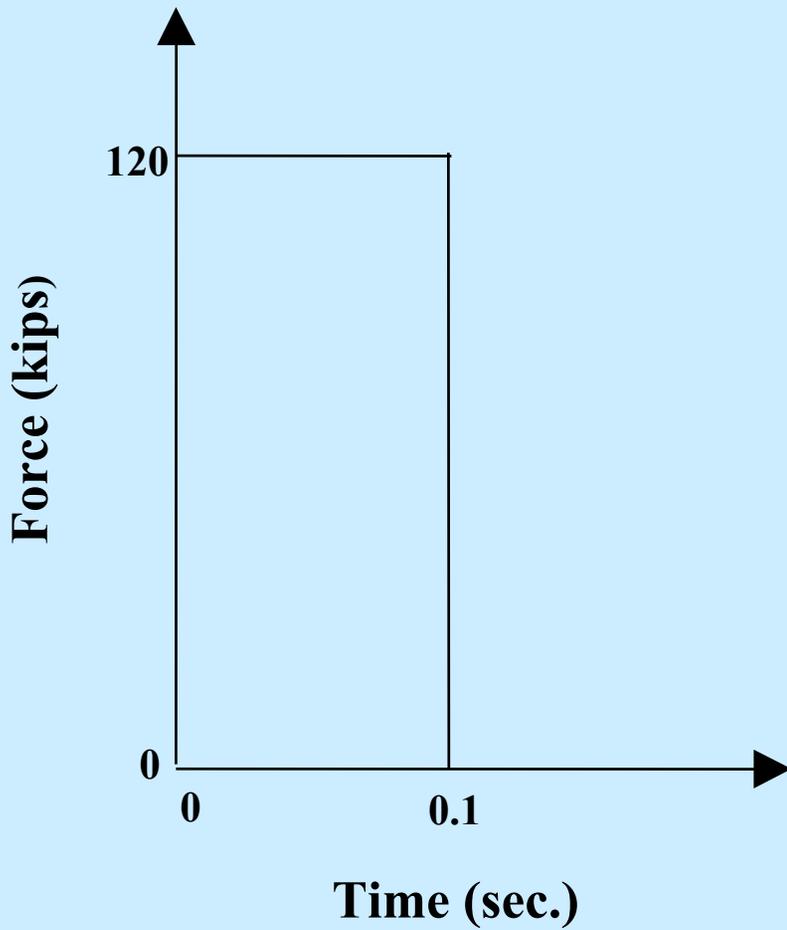
Load Points (cont'd.)



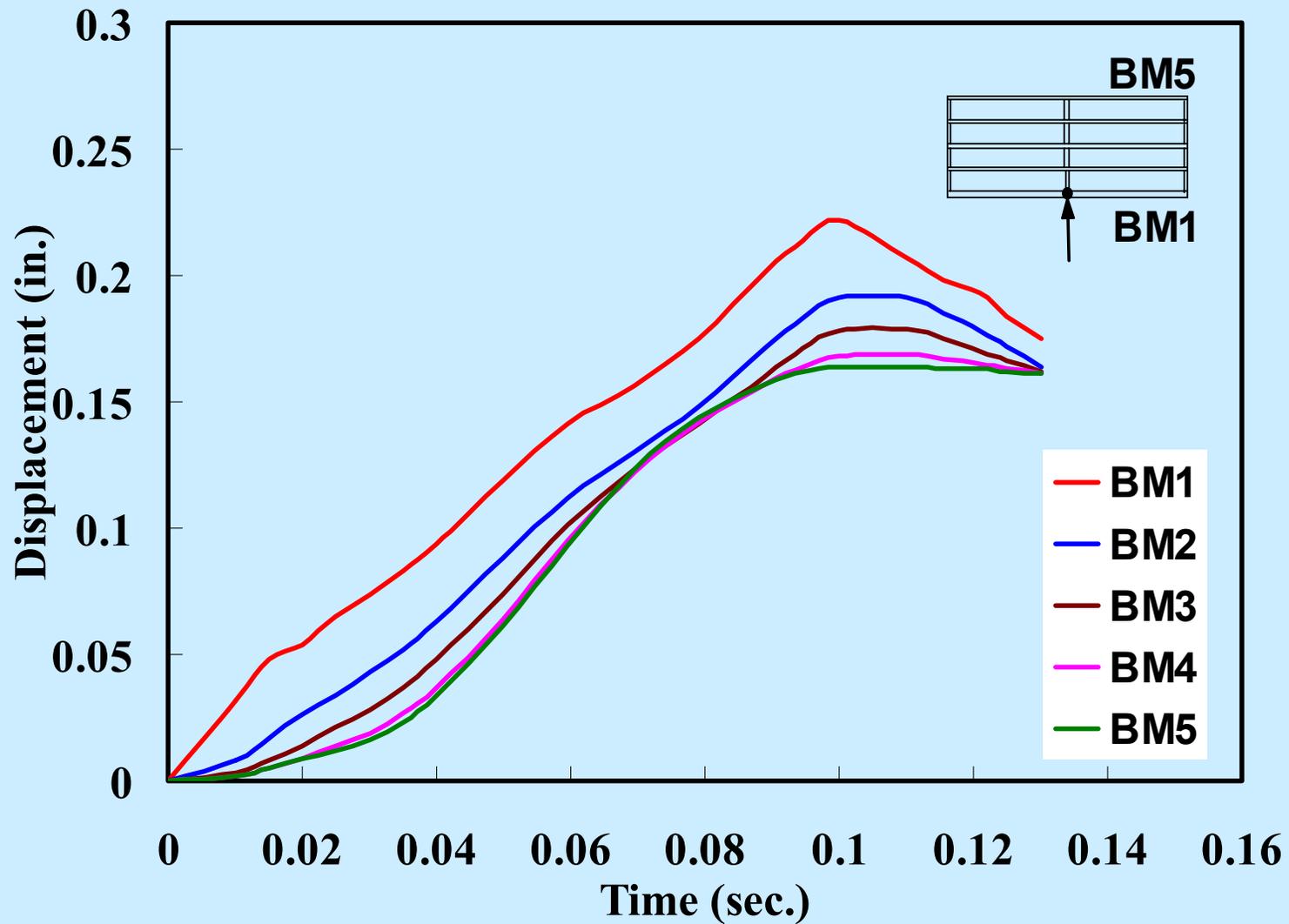
Load Points (cont'd.)

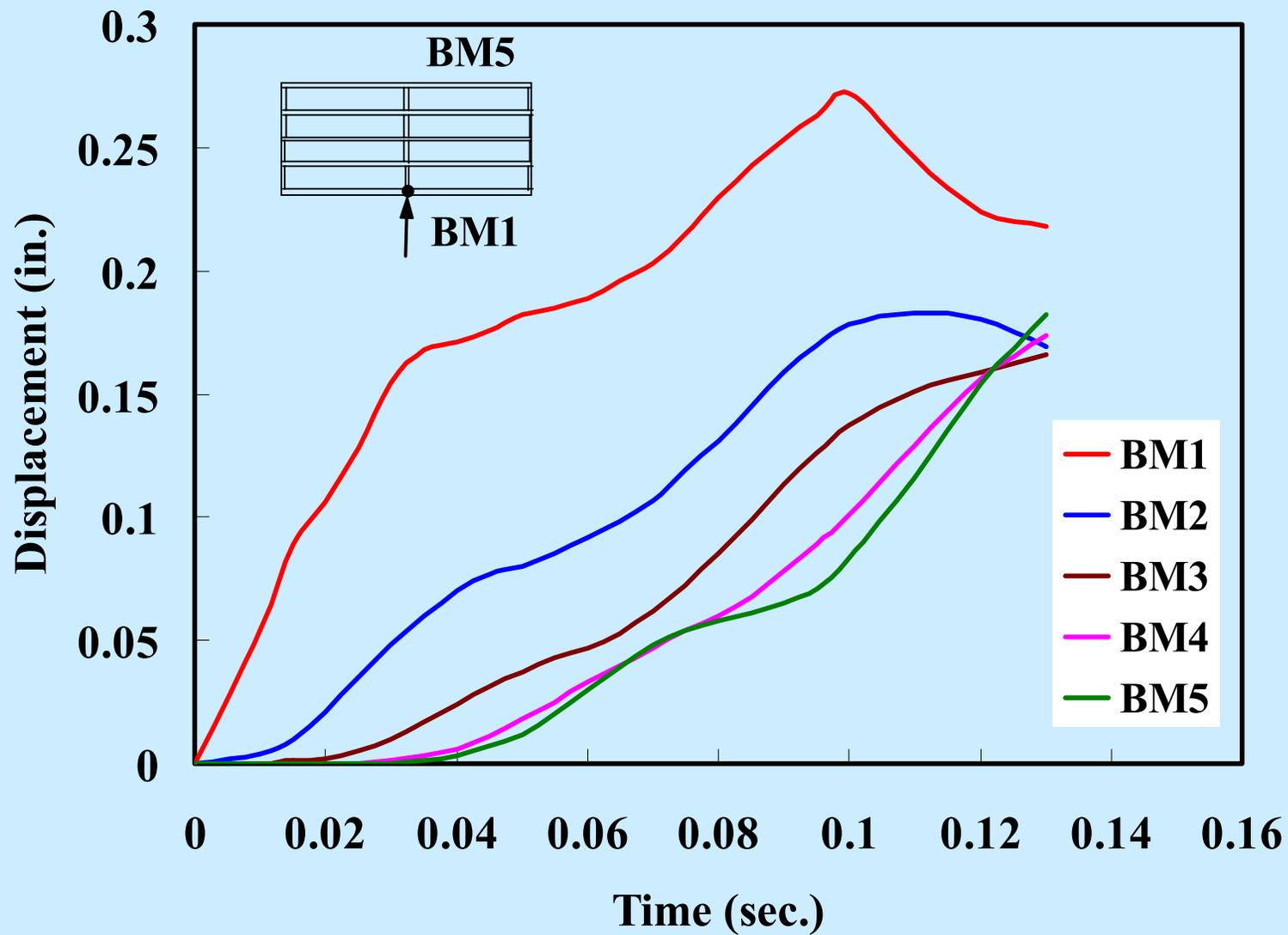


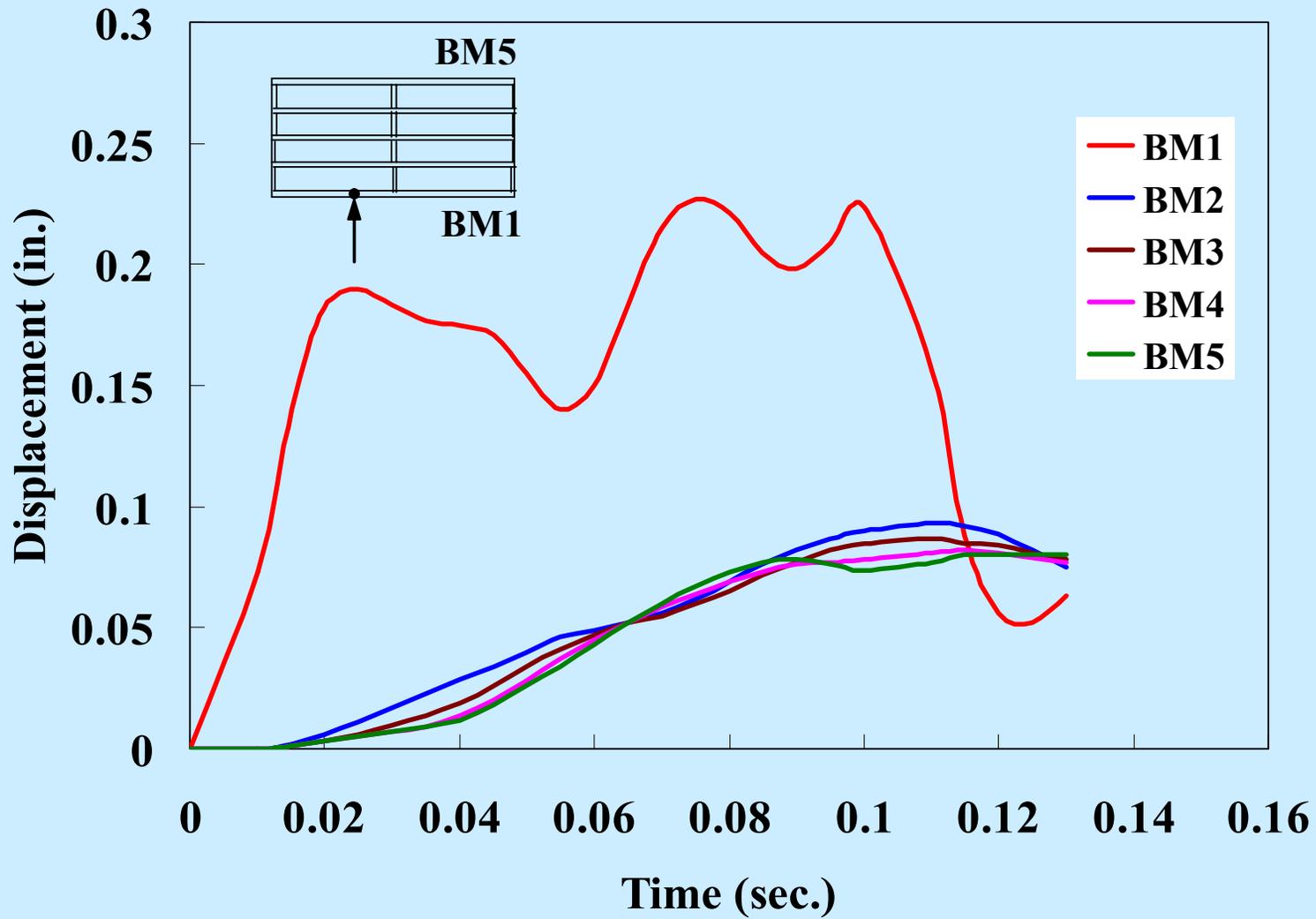
Load Magnitudes and Duration

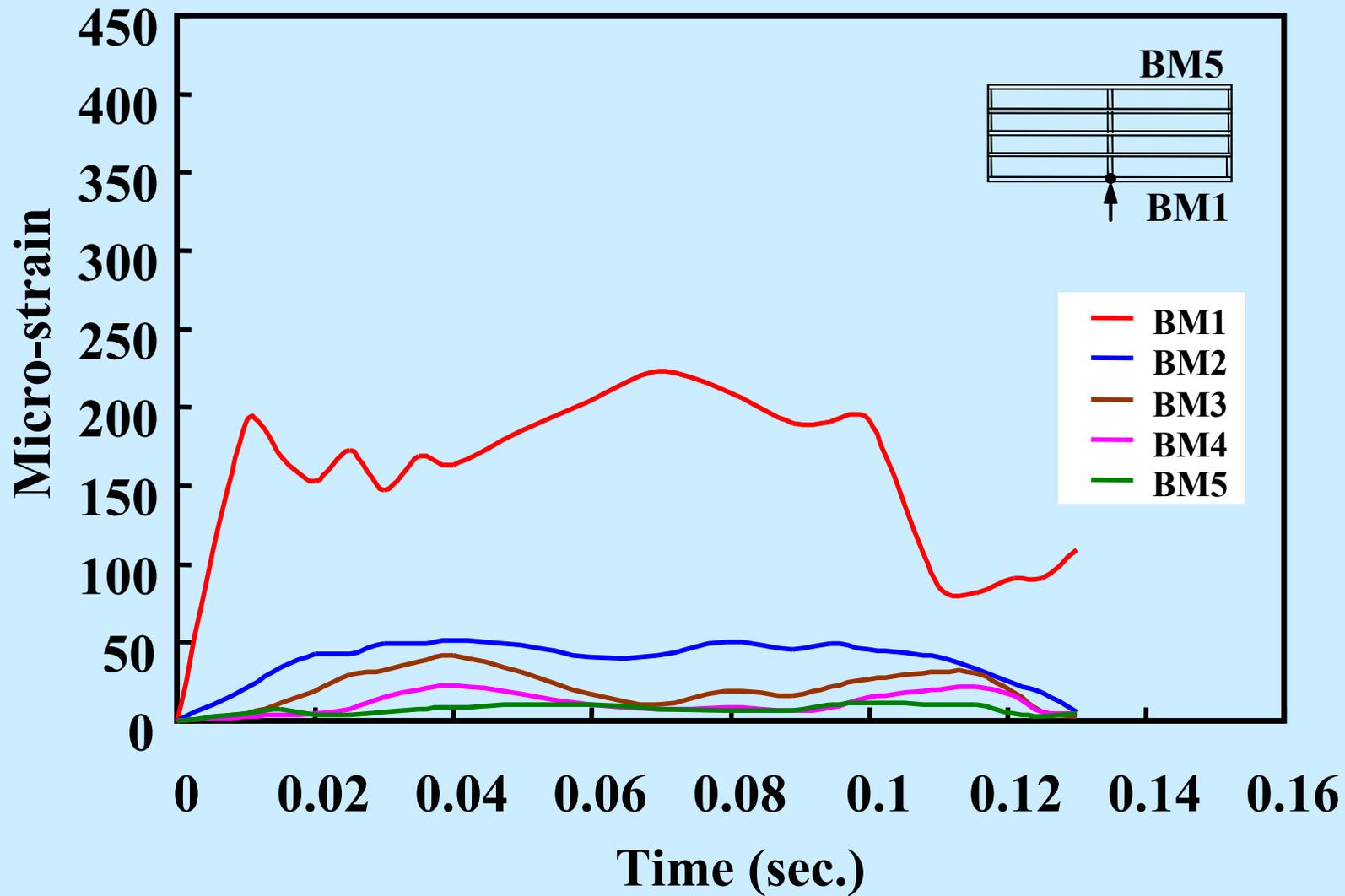


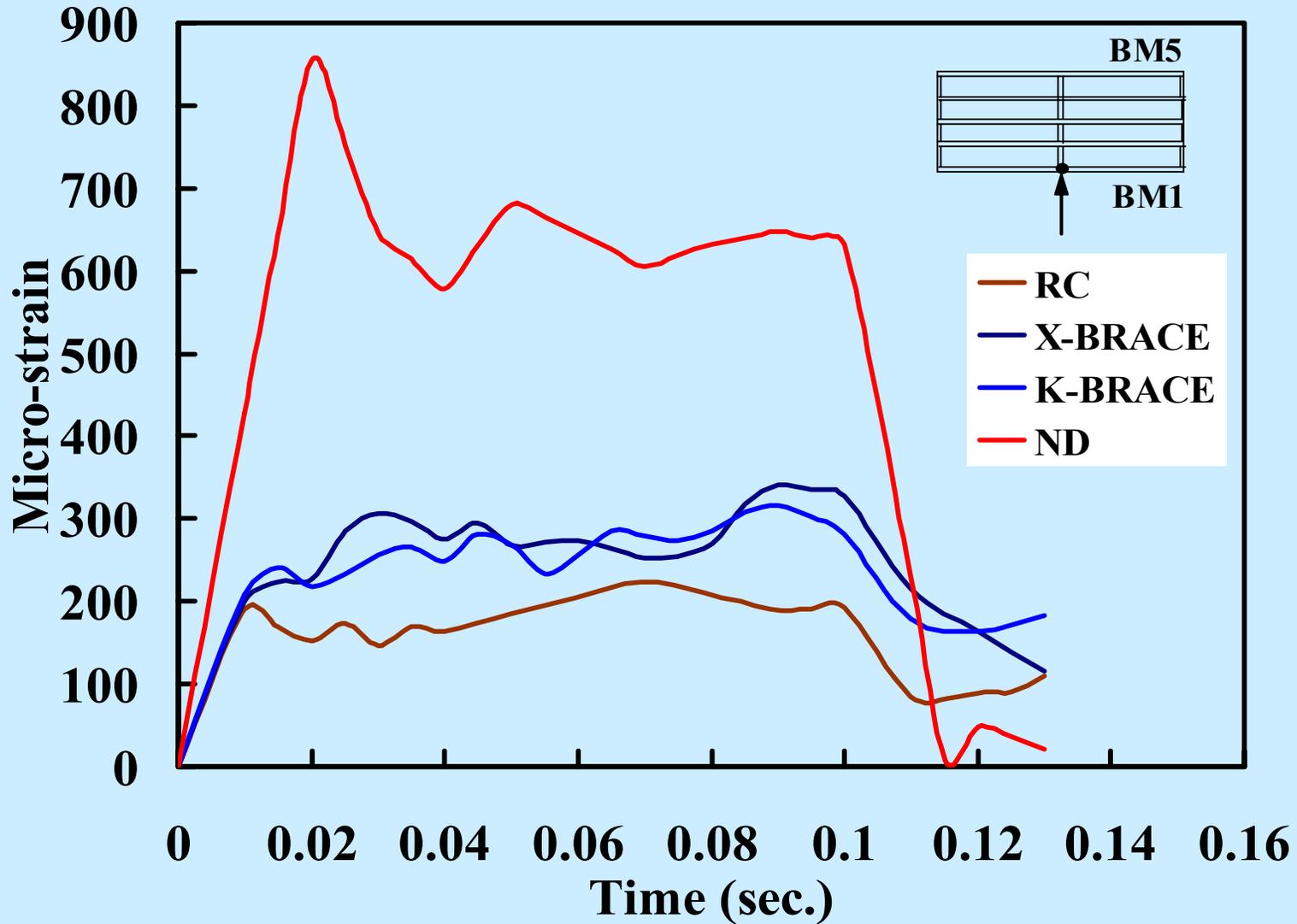
Analytical Results

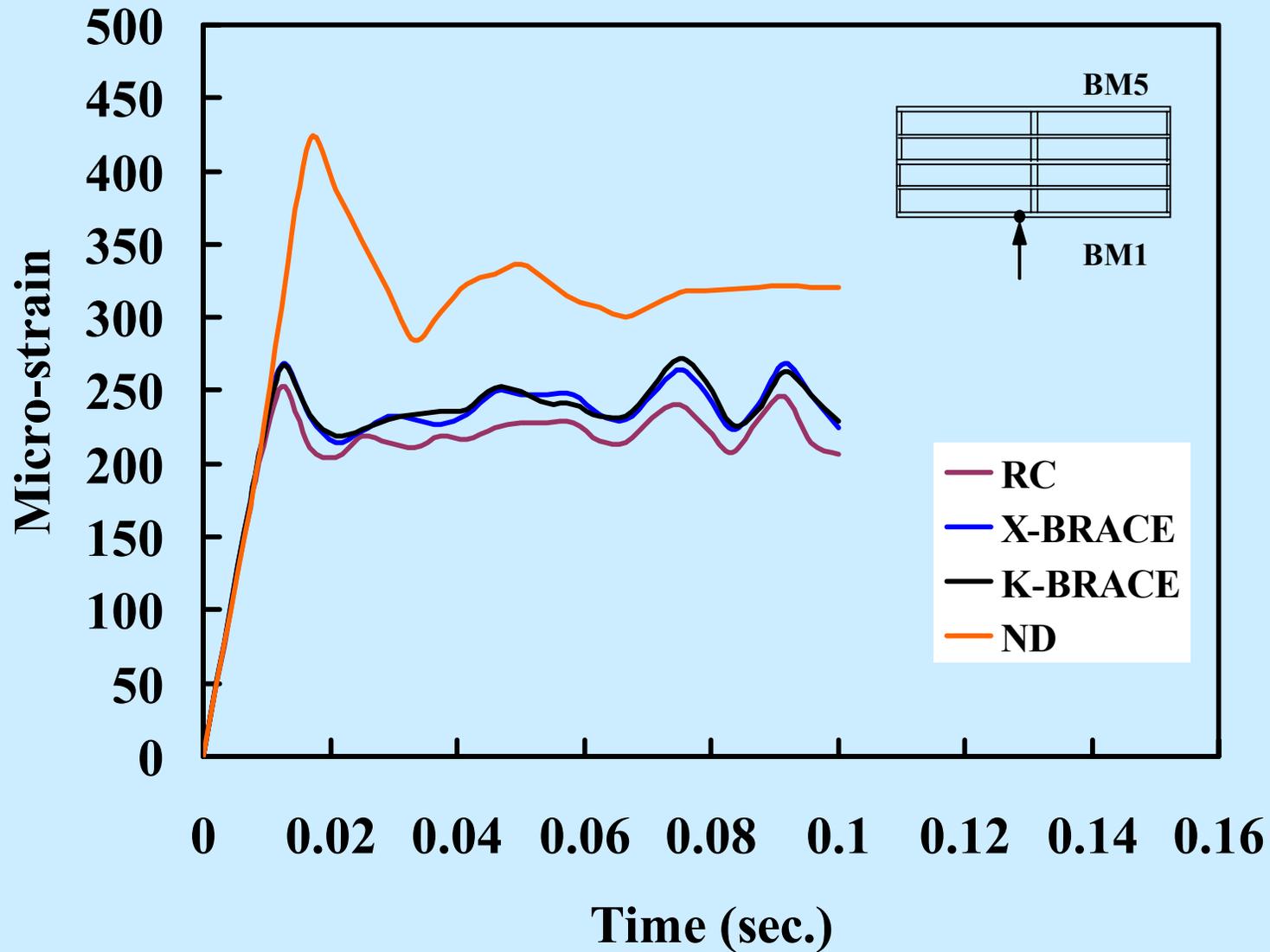


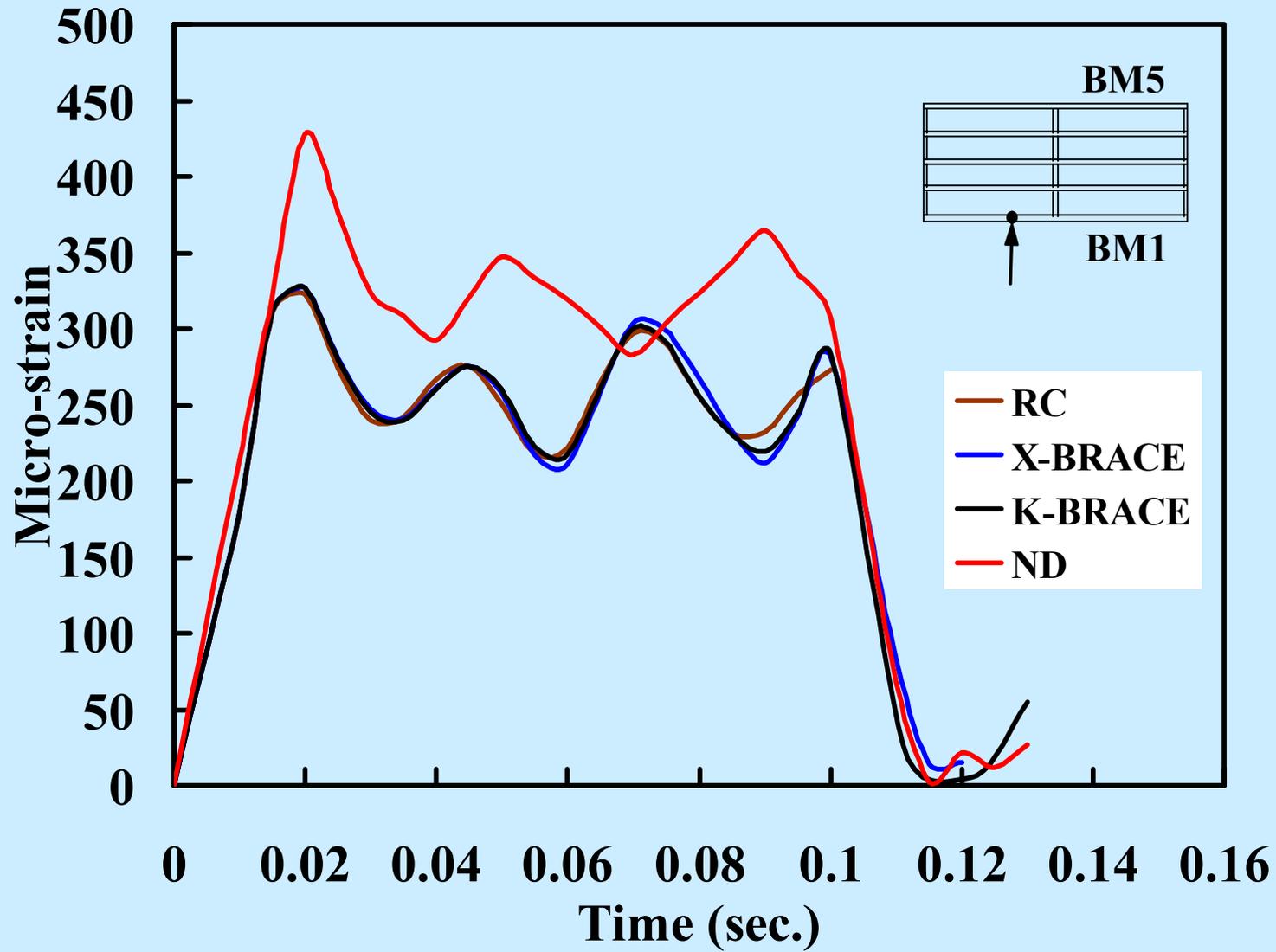


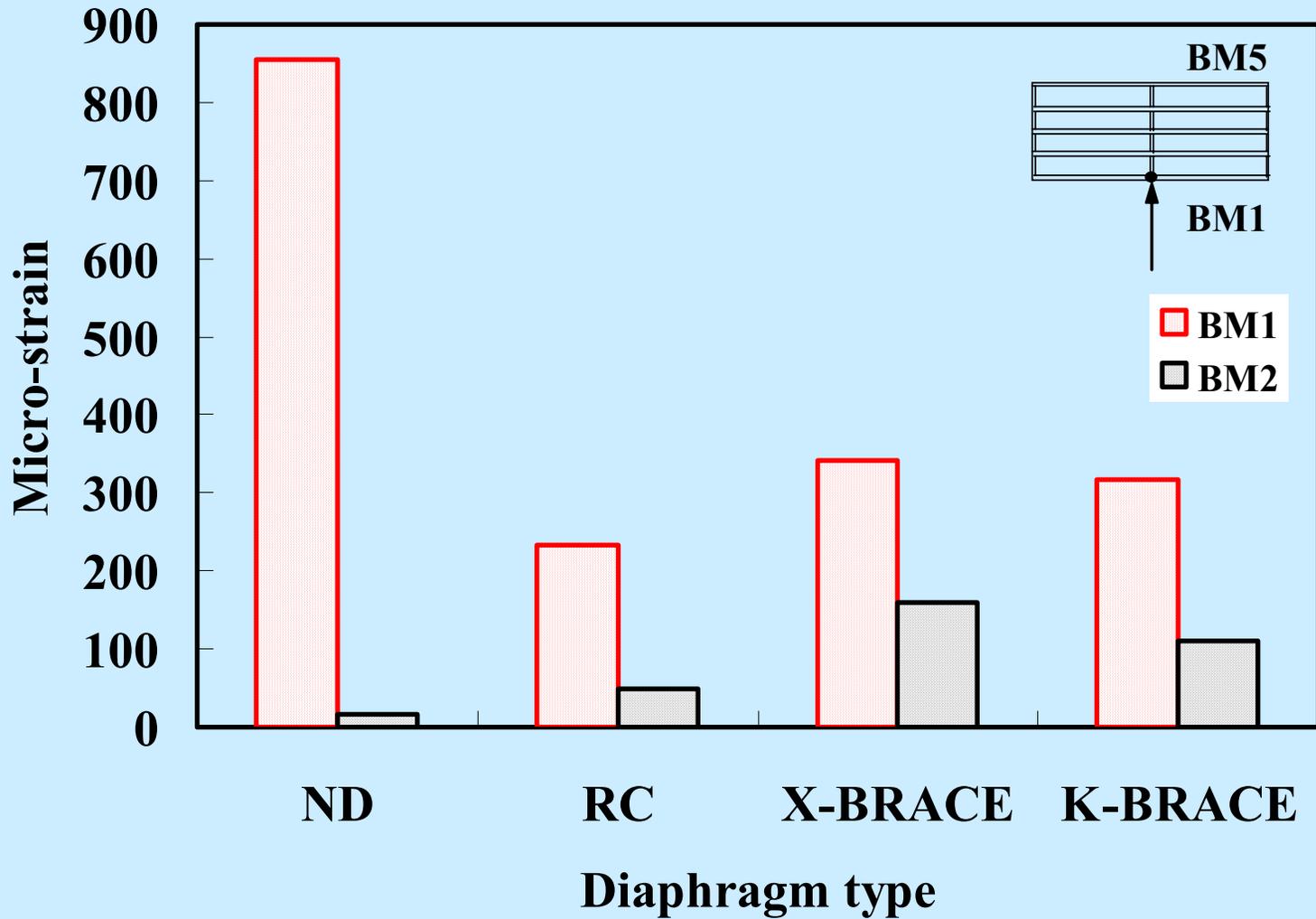


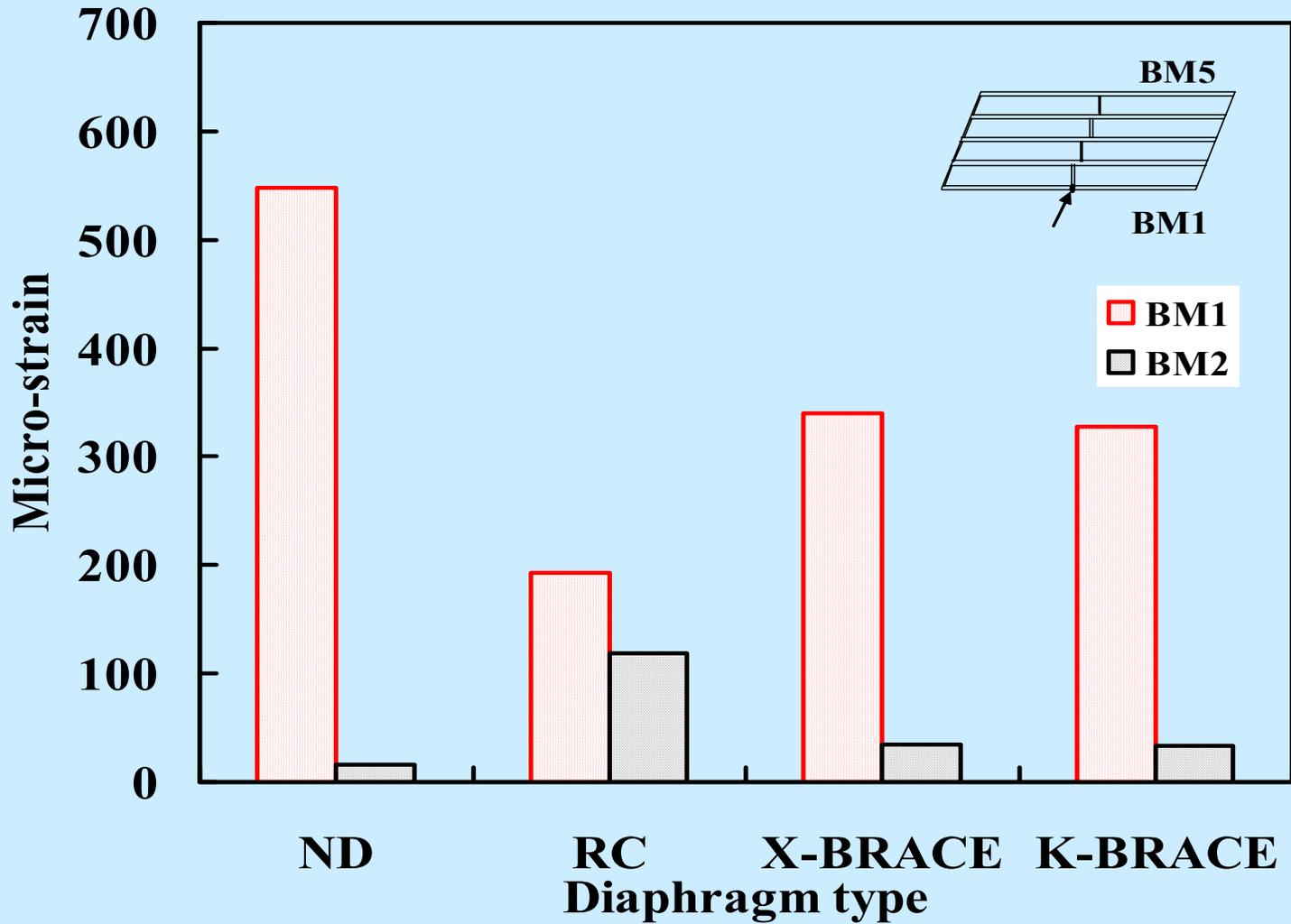


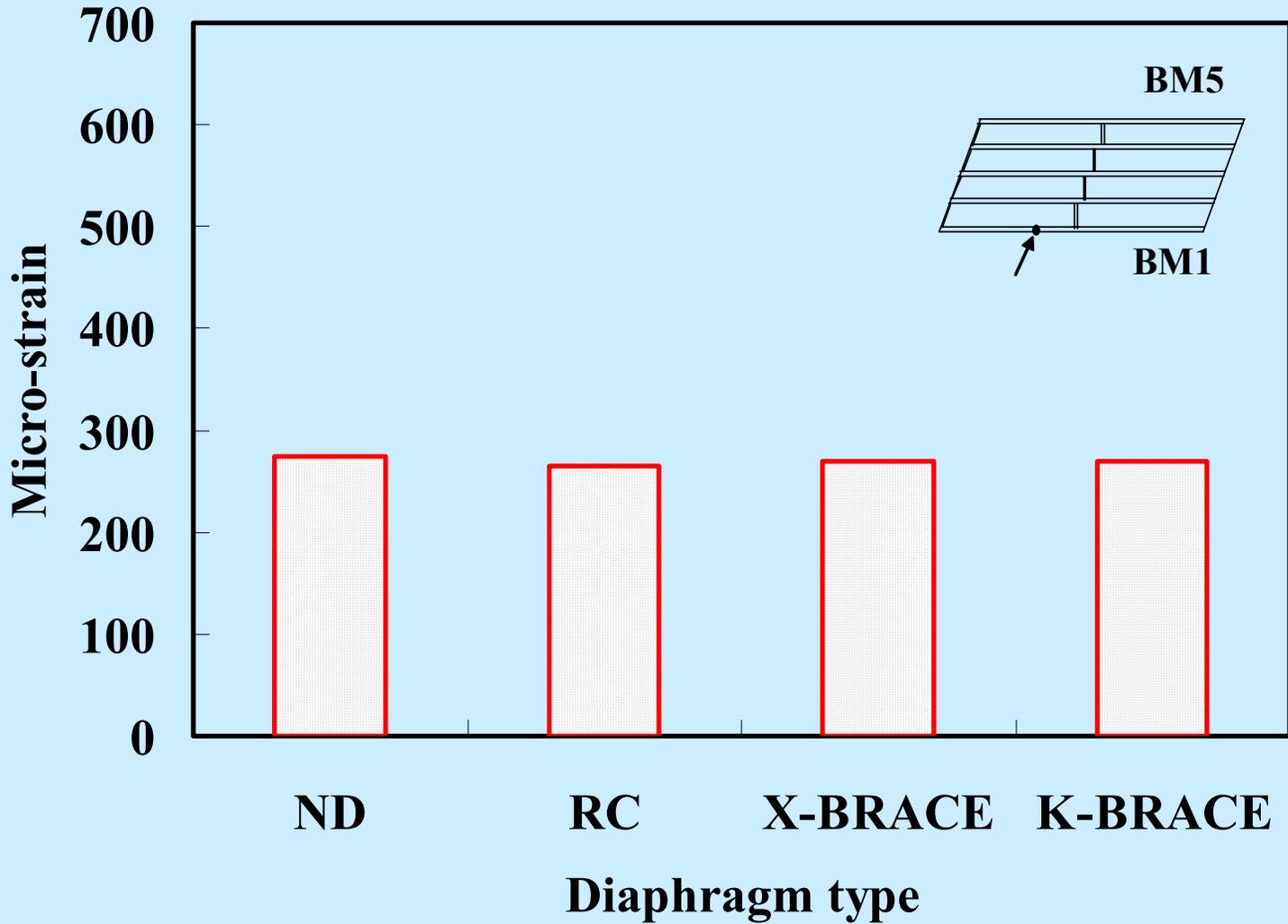












Conclusions

- Impacted girder in non-skewed and skewed bridges
 - Impact at the diaphragm
 - RC induced the smallest tensile strains.
 - Impact not at the diaphragm (most likely)
 - All diaphragms induced similar tensile strains.

Conclusions (cont'd.)

- Girder adjacent to the impacted girder.
 - Impact at the diaphragm in a non-skewed bridge.

Steel induced higher tensile strains.

- Impact at the diaphragm in a skewed bridge.

RC induced higher tensile strains.