1 Structural Dynamics

1.1 Single-story frame

The dynamic response of civil infrastructures, including buildings, bridges, and towers, can be studied by applying fundamental vibrations concepts studied in the previous chapters.

Let's start by considering the single-story frame shown in Fig. 1.1 (a) in free vibration (no external load is applied to the structure). The frame has height H and bay width L. As shown in Fig. 1.1, the frame consists of two columns with modulus of elasticity E and moment of inertia (second moment of the cross sectional area) I. The columns are fixed at the base. The frame in Fig. 1.1 (a) can be modeled as a single-degree of freedom (SDOF) system under the following assumptions:

- Shear building: flexible columns ($EI \neq 0$), beam infinitely rigid ($EI_b = \infty$), axial deformations of beams and columns negligible ($EA = 0$);
- Lumped mass system: floor-mass concentrated at the floor level.

Fig. 1.1 (b) illustrates a SDOF with mass m and stiffness k that can be used to model the dynamic behavior of the single-story frame considering no damping ($\zeta = 0$).

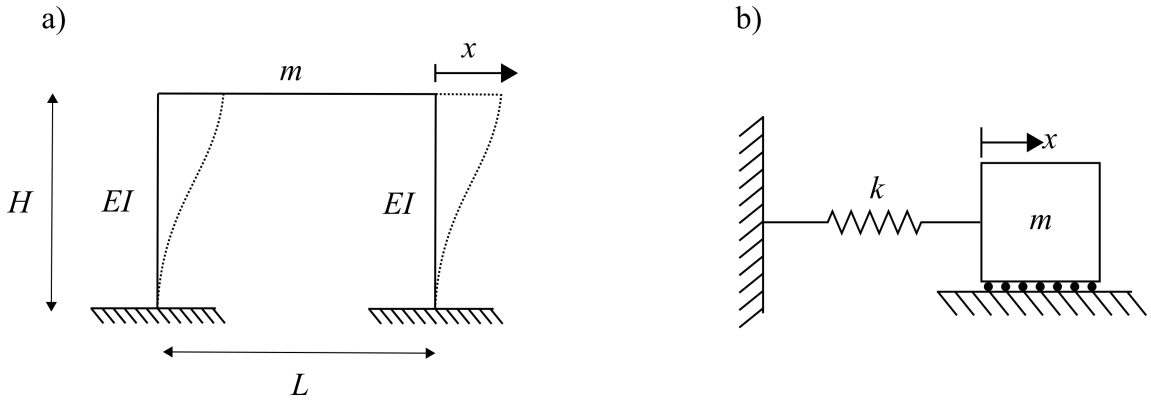

Figure 1.1: (a) Single story frame; (b) undamped single degree of freedom system.

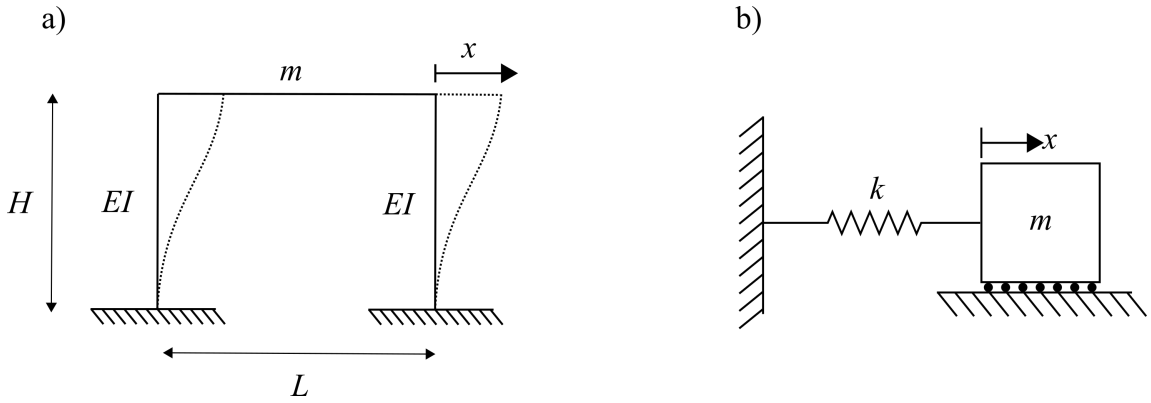

Figure 1.2: (a) Single story frame; (b) undamped single degree of freedom system.

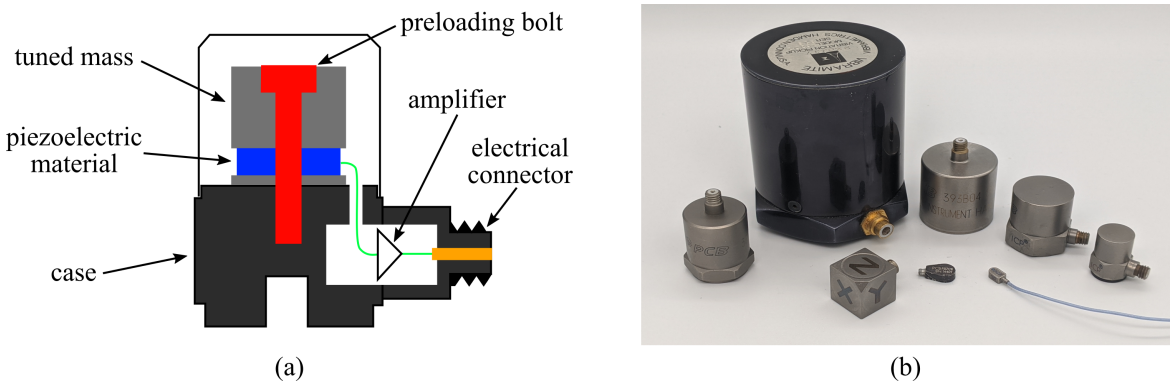

Figure 1.3: Integrated Electronics Piezo-Electric (IEPE) accelerometers, showing: (a) the cross section of a typical IEPE) accelerometer with key components annotated, and; (b) selection of IEPE accelerometers for various applications.