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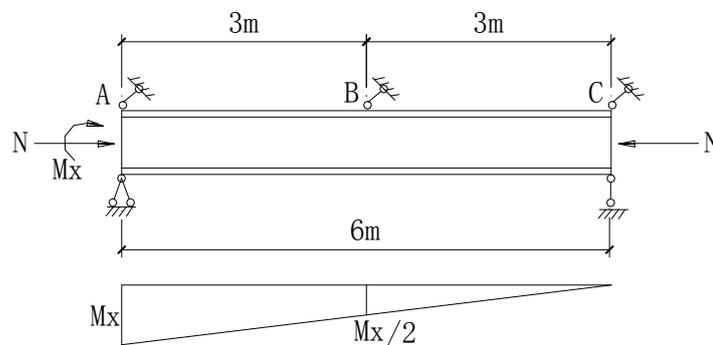
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Endurance time: min.

**P1.** As shown in the figure below, a member subjected to combined bending moment and axial compressive force is pinned (in-plane) at both two ends and laterally supported at two ends and the middle of the span. The member is 6-meter-long and has a hot-rolled section I36a ( $A = 76.44\text{cm}^2$ ,  $W_x = 877.6\text{cm}^3$ ,  $i_x = 12.38\text{cm}$ ,  $i_y = 2.69\text{cm}$ ). The axial compressive force acting on the member is  $N=350\text{kN}$ , and the bending moment only applied at support A is  $M_x=100\text{kN}\cdot\text{m}$ . All structural steel is Q235 with design value of steel strength  $f = 215\text{ N/mm}^2$ . Please check the stability of the member. (15 point)

The overall stability coefficient of a bending member can be calculated by

$$\varphi_b = 1.07 - \frac{\lambda_y^2}{44000} \cdot \frac{f_y}{235}, \text{ and the plastic adaptation factor } \gamma_x = 1.05.$$



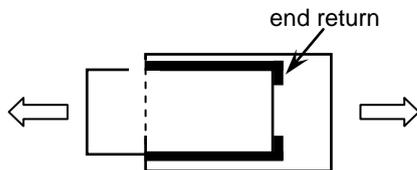
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1. **Q:** Earthquake action is a type of repeated loading, but in seismic design for a steel structure fatigue calculation based on stress-range-method is rarely used. Please state the reason. (4 points)
2. **Q:** In the design of section capacity for bending members, members subjected to combined bending moment and axial force, three design criteria can be adopted: yield only at extreme fibre, full yield of the entire section and partial of the section yield. (a) what is the criteria of partial of the section yield? (b) what is the advantage of using this partially yield criteria? (c) under what load conditions it is not appropriate to use this partially yield criteria? (5 points)
3. **Q:** When an I-shaped steel girder is subjected to a concentrated load (for example, transferred from a secondary beam or supports), the local stress due to the transverse force should be checked. If it is not satisfied, the following measures/details could be used: (a) increase the flange thickness of the girder; (b) increase the flange width of the girder; (c) increase the web thickness of the girder; (d) increase the web height of the girder; (e) add transverse stiffeners to the girder; (f) increase the contact length of the concentrated load on the girder. Which are the measures that are both effective and economical? (4 points)
4. **Q:** An end return is used in a fillet welded connection, as shown in the figure below. Why use end return in the connection? (4 points)



5. **Q:** A high-strength bolted slip-critical connection is out of work due to slip between two surfaces, could it continue to carry larger load after this? Please state your reasons. (4 points)