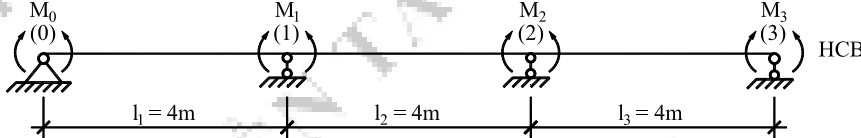
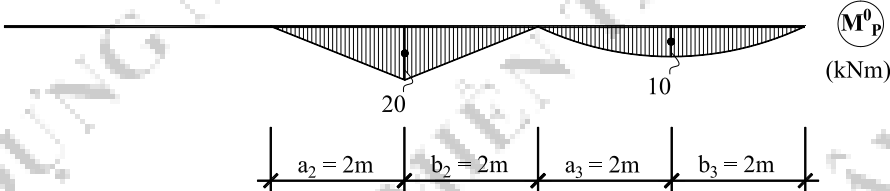
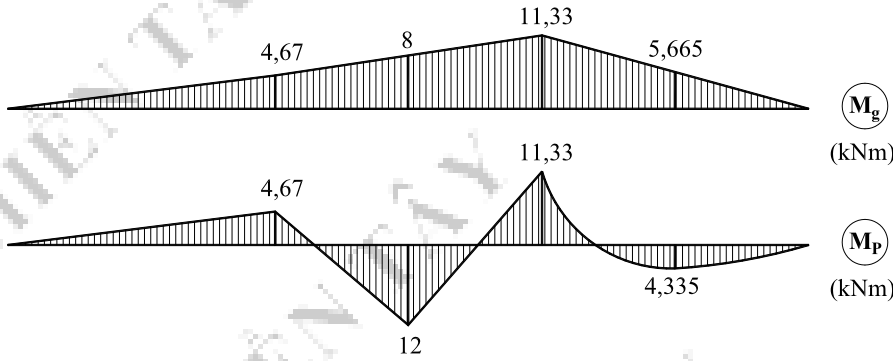
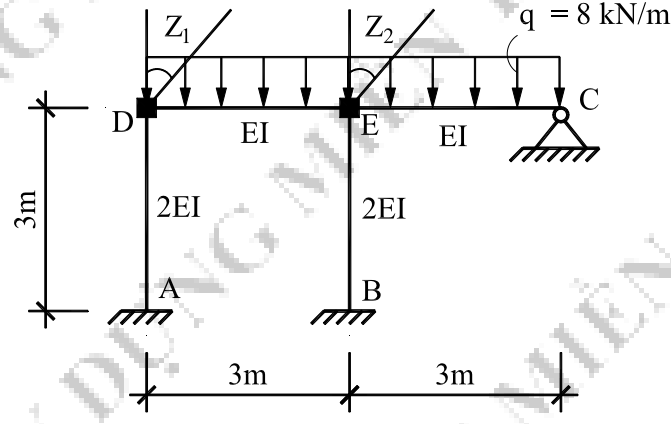
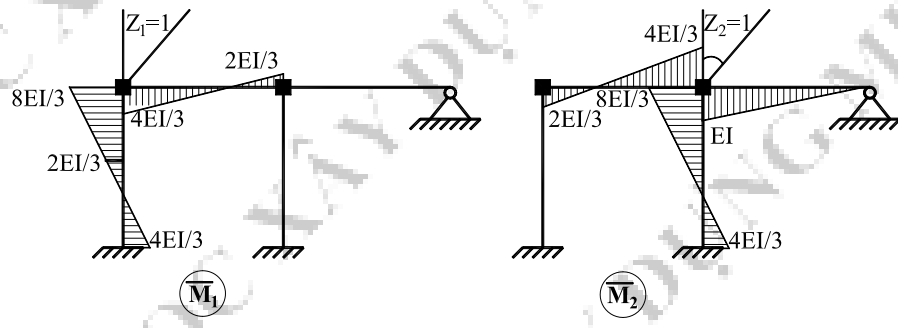
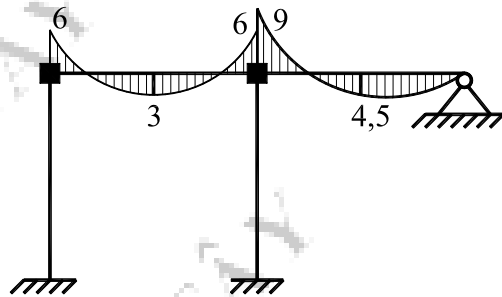
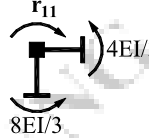
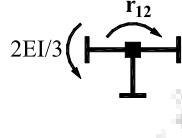
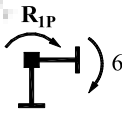
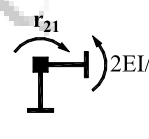
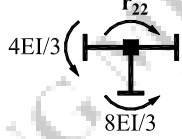
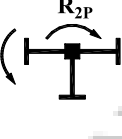
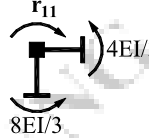
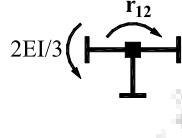
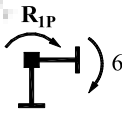
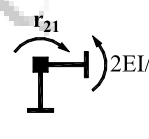
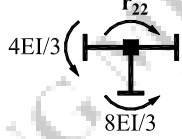
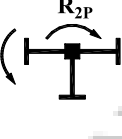
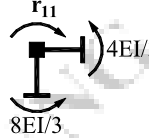
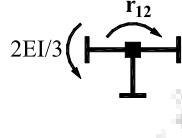
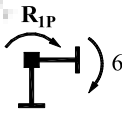
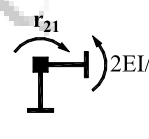
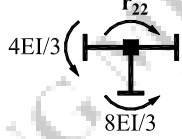
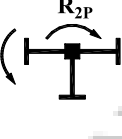
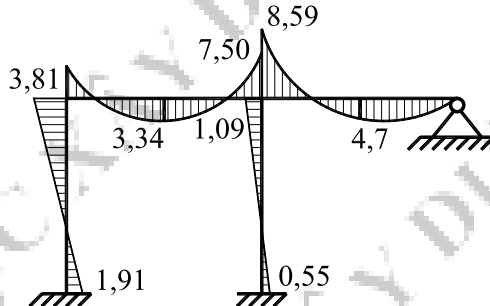


| Câu | Phần | Nội dung                                                                                                                                                                                                                                                                                                                                                                                      | Thang điểm |
|-----|------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------|
| 1   |      | <p>- Bậc siêu tĩnh <math>n = 2</math>, đặt tên các gối, nhịp và chọn hệ cơ bản như hình vẽ:</p>                                                                                                                                                                                                             | 0,5        |
|     |      | <p>- Vẽ biểu đồ mômen (<math>M_p^0</math>) như hình vẽ:</p>                                                                                                                                                                                                                                                 | 1,0        |
|     |      | <p>- Viết các phương trình ba mômen:</p> <p>+ Gối 1 (<math>i = 1</math>): <math>l_1 M_0 + 2(l_1 + l_2)M_1 + l_2 M_2 = -6 \left( \frac{\omega_1 a_1}{l_1} + \frac{\omega_2 b_2}{l_2} \right)</math></p> <p>+ Gối 2 (<math>i = 2</math>): <math>l_2 M_1 + 2(l_2 + l_3)M_2 + l_3 M_3 = -6 \left( \frac{\omega_2 a_2}{l_2} + \frac{\omega_3 b_3}{l_3} \right)</math></p>                          | 0,5        |
|     |      | <p>- Tính các hệ số:</p> <p><math>\omega_1 a_1 = 0</math></p> <p><math>\omega_2 b_2 = \left( \frac{20 \times 4}{2} \right) \times 2 = 80 \text{ kNm}^3</math></p> <p><math>\omega_2 a_2 = \left( \frac{20 \times 4}{2} \right) \times 2 = 80 \text{ kNm}^3</math></p> <p><math>\omega_3 b_3 = \left( \frac{2}{3} \times 10 \times 4 \right) \times 2 = \frac{160}{3} \text{ kNm}^3</math></p> | 0,5        |
|     |      | <p>- Giải hệ phương trình:</p> $\begin{cases} 16M_1 + 4M_2 = -120 \\ 4M_1 + 16M_2 = -200 \end{cases}$ <p><math>\Rightarrow \begin{cases} M_1 = -\frac{14}{3} = -4,67 \text{ kNm} \\ M_2 = -\frac{34}{3} = -11,33 \text{ kNm} \end{cases}</math></p>                                                                                                                                           | 0,25       |
|     |      |                                                                                                                                                                                                                                                                                                                                                                                               | 0,25       |

| Câu                    | Phần | Nội dung                                                                                                                                                                                                                                                                                                                                                                                                  | Thang điểm  |
|------------------------|------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------|
|                        |      | <p>- Vẽ biểu đồ mômen uốn (<math>M_g</math>) từ đó suy ra biểu đồ mômen (<math>M_p</math>) của dầm như hình vẽ: <math>(M_p) = (M_p^0) + (M_g)</math></p>                                                                                                                                                                | 1,0         |
| <b>Tổng điểm câu 1</b> |      |                                                                                                                                                                                                                                                                                                                                                                                                           | <b>4,0đ</b> |
| 2                      |      | <p>- Bậc siêu động <math>n = 2</math>, chọn hệ cơ bản như hình vẽ:</p>  <p style="text-align: center;"><b>"HCB"</b></p> <p>+ Vẽ biểu đồ mômen uốn (<math>\overline{M}_1</math>) và (<math>\overline{M}_2</math>) như hình vẽ.</p>  | 1,0         |

| Câu                                                                                                    | Phần                                                                                                  | Nội dung                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | Thang điểm                                                                                          |                                                                                                       |                                                                                                      |                                                                                                        |                                                                                                      |                                                                                                       |            |
|--------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------|------------|
|                                                                                                        |                                                                                                       | <p>+ Vẽ biểu đồ mômen uốn (<math>M_p^0</math>) như hình vẽ.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | 1,0                                                                                                 |                                                                                                       |                                                                                                      |                                                                                                        |                                                                                                      |                                                                                                       |            |
|                                                                                                        |                                                                                                       | <p>+ Viết hệ phương trình chính tắc</p> $\begin{cases} r_{11}Z_1 + r_{12}Z_2 + R_{1p} = 0 \\ r_{21}Z_1 + r_{22}Z_2 + R_{2p} = 0 \end{cases}$                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | 0,5                                                                                                 |                                                                                                       |                                                                                                      |                                                                                                        |                                                                                                      |                                                                                                       |            |
|                                                                                                        |                                                                                                       | <p>+ Tính các hệ số:</p> <table><tr><td><br/><math>r_{11} = 4EI</math></td><td><br/><math>r_{12} = 2EI/3</math></td><td><br/><math>R_{1p} = -6</math></td></tr><tr><td><br/><math>r_{21} = 2EI/3</math></td><td><br/><math>r_{22} = 5EI</math></td><td><br/><math>R_{2p} = -3</math></td></tr></table> | <br>$r_{11} = 4EI$ | <br>$r_{12} = 2EI/3$ | <br>$R_{1p} = -6$ | <br>$r_{21} = 2EI/3$ | <br>$r_{22} = 5EI$ | <br>$R_{2p} = -3$ | 0,5<br>0,5 |
| <br>$r_{11} = 4EI$    | <br>$r_{12} = 2EI/3$ | <br>$R_{1p} = -6$                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |                                                                                                     |                                                                                                       |                                                                                                      |                                                                                                        |                                                                                                      |                                                                                                       |            |
| <br>$r_{21} = 2EI/3$ | <br>$r_{22} = 5EI$  | <br>$R_{2p} = -3$                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |                                                                                                     |                                                                                                       |                                                                                                      |                                                                                                        |                                                                                                      |                                                                                                       |            |
|                                                                                                        |                                                                                                       | <p>+ Giải hệ phương trình chính tắc, ta có:</p> $\Rightarrow \begin{cases} Z_1 = \frac{63}{44EI} = \frac{1,43}{EI} \text{ (rad)} \\ Z_2 = \frac{9}{22EI} = \frac{0,41}{EI} \text{ (rad)} \end{cases}$                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | 0,25<br>0,25                                                                                        |                                                                                                       |                                                                                                      |                                                                                                        |                                                                                                      |                                                                                                       |            |
|                                                                                                        |                                                                                                       | <p>- Vẽ biểu đồ mômen của hệ như hình vẽ.</p> $M_p = M_p^0 + (\overline{M}_1)Z_1 + (\overline{M}_2)Z_2$                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | 1,0                                                                                                 |                                                                                                       |                                                                                                      |                                                                                                        |                                                                                                      |                                                                                                       |            |
| Tổng điểm câu 2                                                                                        |                                                                                                       |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | 6,0đ                                                                                                |                                                                                                       |                                                                                                      |                                                                                                        |                                                                                                      |                                                                                                       |            |