

ANEXO. DISEÑO DE ELEMENTOS NO ESTRUCTURALES

10.1 DINTELES

■ MEMBER NAME : DINTEL 12X20 [Section : END(I)]

1. General Information

- (1) Design Code : NSR-10
- (2) Unit System : N, mm

2. Material

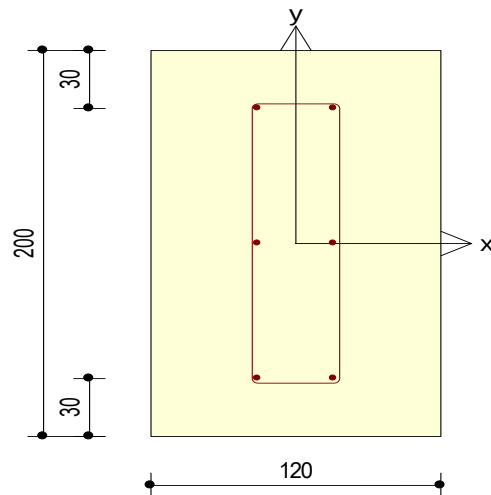
- (1) F'_c : 20.68MPa
- (2) F_y : 400MPa
- (3) F_{ys} : 400MPa

3. Section

- (1) Section Size : 120 x 200mm (R-Section)
- (2) Cover : 30.00mm
- (3) Compression : Not Considered
- (4) Splicing Limit : 50%
- (5) Span : 0.000m

4. Seismic Design Parameters

- (1) Special provisions for seismic design is applied.
- (2) Frame Type : DMI(Minimum Energy Dissipation)



5. Moments and Forces

- (1) $M_{u,top}$: 0.000kN·m
- (2) $M_{u,bottom}$: 0.000kN·m
- (3) V_u : 29.42kN

6. Reinforcement

- (1) Top Bar : 2-#3 ($A_s = 142\text{mm}^2$)
 - Layer 1 : 2 EA ($C_c = 44.29\text{mm}$)
- (2) Bot Bar : 2-#3 ($A_s = 142\text{mm}^2$)
 - Layer 1 : 2 EA ($C_c = 44.29\text{mm}$)
- (3) Stirrup : 2-#3@76.20 ($A_s = 142\text{mm}^2$)
- (4) Skin Bar : 1-#3 ($A_s = 70.97\text{mm}^2$) (at Tension Region)

7. Check Bending Moment Capacity (Positive)

- (1) Calculate design parameter
 - $\beta_1 = 0.85 - 0.007 (f'_c - 28) = 0.850$
- (2) Check space of rebar
 - Moment is zero. Skipped.
- (3) Calculate required ratio of reinforcement
 - Moment is zero. Skipped.
- (4) Calculate moment capacity
 - Moment is zero. Skipped.

8. Check Bending Moment Capacity (Negative)

- (1) Calculate design parameter
 - $\beta_1 = 0.85 - 0.007 (f'_c - 28) = 0.850$
- (2) Check space of rebar
 - Moment is zero. Skipped.
- (3) Calculate required ratio of reinforcement
 - Moment is zero. Skipped.
- (4) Calculate moment capacity
 - Moment is zero. Skipped.

9. Check Shear Capacity

- (1) Calculate shear strength by concrete
 - $\phi = 0.750$ $d = 156\text{mm}$
 - $\phi V_c = \phi 0.17 \sqrt{f'_c} b_w d = 10.84\text{kN}$
 - $V_u > \phi V_c \rightarrow$ Shear reinforcement is required
- (2) Calculate required shear strength by shear reinforcement
 - $V_{s,req} = (V_u - \phi V_c) / \phi = 24.78\text{kN}$
 - $V_{c1} = 0.33 \sqrt{f'_c} b_w d = 28.04\text{kN}$ Refer to [11.4.5.3]
 - $V_{c2} = 0.66 \sqrt{f'_c} b_w d = 56.09\text{kN}$
 - $V_{s,req} < V_{c2} \rightarrow \text{O.K}$
 - $A_{v,min1/s}$
 - $A_{v,min} / s = \min [A_{v,min1} / s , A_{v,min2} / s] = 0.105\text{mm}^2/\text{mm}$
 - $A_{v,req0} / s = 0.398\text{mm}^2/\text{mm}$
 - $A_{v,req} / s = \max [A_{v,min} / s , A_{v,req0} / s] = 0.398\text{mm}^2/\text{mm}$
- (3) Calculate shear strength by stirrup
 - $N_{leg} = 2$ $A_{v1} = 70.97\text{mm}^2$ (#3)
 - $\phi V_s = 42.07\text{kN}$
- (4) Calculate ratio of shear capacity
 - $\phi V_n = \phi V_c + \phi V_s = 52.90\text{kN}$
 - $V_u / \phi V_n = 0.556 \rightarrow \text{O.K}$
- (5) Calculate spacing limits for reinforcement
 - $s_{max,0} = \min [d/2, 600\text{mm}] = 77.86\text{mm}$
 - $s_{req} = 357\text{mm}$
 - $s_{max} = \min [s_{max,0} , s_{req}] = 77.86\text{mm}$
 - $s = 76.20\text{mm} < s_{max} = 77.86\text{mm} \rightarrow \text{O.K}$

10. Check Rebar Diameter by Seismic Provision

- (1) Check main bar diameter

- $d_{main,limit} = 0.000\text{mm}$
- $d_{main} = \min(d_{top} , d_{bot}) = 9.525\text{mm}$
- $d_{main} < d_{main,limit} \rightarrow \text{O.K}$

■ MEMBER NAME : DINTEL 12X20 [Section : MIDDLE]

1. General Information

- (1) Design Code : NSR-10
- (2) Unit System : N, mm

2. Material

- (1) F'_c : 20.68MPa
- (2) F_y : 400MPa
- (3) F_{ys} : 400MPa

3. Section

- (1) Section Size : 120 x 200mm (R-Section)
- (2) Cover : 30.00mm
- (3) Compression : Not Considered
- (4) Splicing Limit : 50%
- (5) Span : 0.000m

4. Seismic Design Parameters

- (1) Special provisions for seismic design is applied.
- (2) Frame Type : DMI(Minimum Energy Dissipation)

5. Moments and Forces

- (1) $M_{u,top}$: 1.373kN·m
- (2) $M_{u,bottom}$: 0.000kN·m
- (3) V_u : 29.42kN

6. Reinforcement

- (1) Top Bar : 2-#3 ($A_s = 142\text{mm}^2$)
 - Layer 1 : 2 EA ($C_c = 44.29\text{mm}$)
- (2) Bot Bar : 2-#3 ($A_s = 142\text{mm}^2$)
 - Layer 1 : 2 EA ($C_c = 44.29\text{mm}$)
- (3) Stirrup : 2-#3@76.20 ($A_s = 142\text{mm}^2$)
- (4) Skin Bar : 1-#3 ($A_s = 70.97\text{mm}^2$) (at Tension Region)

7. Deflection

- (1) Support Condition : Case-1 (Pin-Pin)
- (2) Span : 1.000m
- (3) Factor
 - Short-term Deflection Factor : Span/480
 - Long-term Deflection Factor : Span/360
 - Duration for sustained load : 60 Months or more
- (4) Design Load
 - Dead Load : 24.52kN/m
 - Live Load : 0.000kN/m
 - Sustained Load : 50.00% of Live Load

8. Check Bending Moment Capacity (Positive)

- (1) Calculate design parameter
 - $\beta_1 = 0.85 - 0.007 (f'_c - 28) = 0.850$
- (2) Check space of rebar
 - Moment is zero. Skipped.
- (3) Calculate required ratio of reinforcement
 - Moment is zero. Skipped.
- (4) Calculate moment capacity
 - Moment is zero. Skipped.

9. Check Bending Moment Capacity (Negative)

- (1) Calculate design parameter
 - $\beta_1 = 0.85 - 0.007 (f'_c - 28) = 0.850$
- (2) Check space of rebar
 - S_{max1} S_{max2}
 - $S_{max} = \min (S_{max1} , S_{max2}) = 300\text{mm}, \quad N_{req} = 2$
 - $s = 31.43 < 300\text{mm} \rightarrow \text{O.K}$
- (3) Calculate required ratio of reinforcement
 - $\rho_{min.11}$
 - $\rho_{min.1} = \max (\rho_{min.11} , \rho_{min.12}) = 0.0035$
 - $\rho_{min.2} = 0.0018$
 - $\rho_{min} = \min (\rho_{min1} , \rho_{min2}) = 0.0018$
 - $\rho_{et} = 0.0160$
 - $\rho_{max} = \rho_{et} = 0.0160$
- (4) Check ratio of tensile reinforcement
 - $\rho = 0.0076$
 - $\rho_{min} < \rho < \rho_{max} \rightarrow \text{O.K}$
- (5) Calculate moment capacity
 - $a = 26.91\text{mm}$
 - $\phi = 0.900$
 - $M_n = A_s f_y (d - a/2) = 8.077\text{kN}\cdot\text{m}$
 - $\phi M_n = 7.269\text{kN}\cdot\text{m}$
- (6) Calculate ratio of moment capacity
 - $M_u / \phi M_n = 0.189 \rightarrow \text{O.K}$

10. Check Shear Capacity

- (1) Calculate shear strength by concrete
 - $\phi = 0.750$ $d = 156\text{mm}$
 - $\phi V_c = \phi 0.17 \sqrt{f'_c} b_w d = 10.84\text{kN}$
 - $V_u > \phi V_c \rightarrow$ Shear reinforcement is required
- (2) Calculate required shear strength by shear reinforcement
 - $V_{s.req} = (V_u - \phi V_c) / \phi = 24.78\text{kN}$
 - $V_{c1} = 0.33 \sqrt{f'_c} b_w d = 28.04\text{kN}$ Refer to [11.4.5.3]
 - $V_{c2} = 0.66 \sqrt{f'_c} b_w d = 56.09\text{kN}$
 - $V_{s.req} < V_{c2} \rightarrow \text{O.K}$
 - $A_{v.min1/s}$
 - $A_{v.min} / s = \min [A_{v.min1} / s , A_{v.min2} / s] = 0.105\text{mm}^2/\text{mm}$
 - $A_{v.req0} / s = 0.398\text{mm}^2/\text{mm}$

- $A_{v,req}/s = \max [A_{v,min}/s , A_{v,req0}/s] = 0.398\text{mm}^2/\text{mm}$
- (3) Calculate shear strength by stirrup
- $N_{leg} = 2$ $A_{v1} = 70.97\text{mm}^2$ (#3)
 - $\phi V_s = \text{iError!} = 42.07\text{kN}$
- (4) Calculate ratio of shear capacity
- $\phi V_n = \phi V_c + \phi V_s = 52.90\text{kN}$
 - $V_u / \phi V_n = 0.556 \rightarrow \text{O.K}$
- (5) Calculate spacing limits for reinforcement
- $S_{max,0} = \min [d/2, 600\text{mm}] = 77.86\text{mm}$
 - $S_{req} = \text{iError!} = 357\text{mm}$
 - $S_{max} = \min [S_{max,0} , S_{req}] = 77.86\text{mm}$
 - $s = 76.20\text{mm} < S_{max} = 77.86\text{mm} \rightarrow \text{O.K}$

11. Check Rebar Diameter by Seismic Provision

- (1) Check main bar diameter
- $d_{main,limit} = 0.000\text{mm}$
 - $d_{main} = \min(d_{top} , d_{bot}) = 9.525\text{mm}$
 - $d_{main} < d_{main,limit} \rightarrow \text{O.K}$

12. Check Deflection

- (1) Criteria for deflection
- For short-term deflection : Span/480
 - For long-term deflection : Span/360
- (2) Time-dependent factor
- Duration for sustained load : 60 Months or more
 - Time-dependent factor for sustained load (ξ) = 2.000
 - $\lambda = 1.449$
- (3) Calculate crack moment of section
- $I_g = 80,000,000\text{mm}^4$
 - $n = E_s / E_c = 9.356$
 - $f_r = 0.62 \sqrt{f'_c} = 2.820\text{MPa}$
 - $M_{cr} = 2.256\text{kN}\cdot\text{m}$
- (4) Calculate positive moment
- $M_D = 3.065\text{kN}\cdot\text{m}$
 - $M_L = 0.000\text{kN}\cdot\text{m}$
 - $M_{D+L} = 3.065\text{kN}\cdot\text{m}$
 - $M_{SUS.} = M_D + 0.50M_L = 3.065\text{kN}\cdot\text{m}$
- (5) Calculate inertia of moment for positive section
- $I_{cr} = 19,847,582\text{mm}^4$
 - $I_{e,D} = 43,838,485\text{mm}^4$
 - $I_{e,D} = 43,838,485\text{mm}^4$
 - $I_{e,D+L} = 43,838,485\text{mm}^4$
 - $I_{e,D+L} = 43,838,485\text{mm}^4$
 - $I_{e,SUS.} = 43,838,485\text{mm}^4$
 - $I_{e,SUS.} = 43,838,485\text{mm}^4$
- (6) Calculate effective inertia of moment
- $I_{e,D} = I_m = 43,838,485\text{mm}^4$
 - $I_{e,D+L} = I_m = 43,838,485\text{mm}^4$

- $I_{e,SUS} = I_m = 43,838,485 \text{ mm}^4$

(7) Calculate deflection

- $K = 1.000$
- $\delta_{i,D} = 0.341 \text{ mm}$
- $\delta_{i,D+L} = 0.341 \text{ mm}$
- $\delta_{i,SUS} = 0.341 \text{ mm}$
- $\delta_{i,L} = \delta_{i,D+L} - \delta_{i,D} = 0.000 \text{ mm}$
- Instantaneous deflection = 0.000mm (Span/0.000 < Span/480 → O.K)
- Long-term deflection = 0.494mm (Span/2,025 < Span/360 → O.K)

■ MEMBER NAME : DINTEL 12X20 [Section : END(J)]

1. General Information

- (1) Design Code : NSR-10
 (2) Unit System : N, mm

2. Material

- (1) F'_c : 20.68MPa
 (2) F_y : 400MPa
 (3) F_{ys} : 400MPa

3. Section

- (1) Section Size : 120 x 200mm (R-Section)
 (2) Cover : 30.00mm
 (3) Compression : Not Considered
 (4) Splicing Limit : 50%
 (5) Span : 0.000m

4. Seismic Design Parameters

- (1) Special provisions for seismic design is applied.
 (2) Frame Type : DMI(Minimum Energy Dissipation)

5. Moments and Forces

- (1) $M_{u,top}$: 0.000kN·m
 (2) $M_{u,bottom}$: 0.000kN·m
 (3) V_u : 29.42kN

6. Reinforcement

- (1) Top Bar : 2-#3 ($A_s = 142 \text{ mm}^2$)
 • Layer 1 : 2 EA ($C_c = 44.29 \text{ mm}$)
 (2) Bot Bar : 2-#3 ($A_s = 142 \text{ mm}^2$)
 • Layer 1 : 2 EA ($C_c = 44.29 \text{ mm}$)
 (3) Stirrup : 2-#3@76.20 ($A_s = 142 \text{ mm}^2$)
 (4) Skin Bar : 1-#3 ($A_s = 70.97 \text{ mm}^2$) (at Tension Region)

7. Check Bending Moment Capacity (Positive)

- (1) Calculate design parameter
 • $\beta_1 = 0.85 - 0.007 (F'_c - 28) = 0.850$
 (2) Check space of rebar
 • Moment is zero. Skipped.
 (3) Calculate required ratio of reinforcement

- Moment is zero. Skipped.
- (4) Calculate moment capacity
- Moment is zero. Skipped.

8. Check Bending Moment Capacity (Negative)

- (1) Calculate design parameter
- $\beta_1 = 0.85 - 0.007 (f'_c - 28) = 0.850$
- (2) Check space of rebar
- Moment is zero. Skipped.
- (3) Calculate required ratio of reinforcement
- Moment is zero. Skipped.
- (4) Calculate moment capacity
- Moment is zero. Skipped.

9. Check Shear Capacity

- (1) Calculate shear strength by concrete
- $\phi = 0.750$ $d = 156\text{mm}$
 - $\phi V_c = \phi 0.17 \sqrt{f'_c} b_w d = 10.84\text{kN}$
 - $V_u > \phi V_c \rightarrow$ Shear reinforcement is required
- (2) Calculate required shear strength by shear reinforcement
- $V_{s,req} = (V_u - \phi V_c) / \phi = 24.78\text{kN}$
 - $V_{c1} = 0.33 \sqrt{f'_c} b_w d = 28.04\text{kN}$ Refer to [11.4.5.3]
 - $V_{c2} = 0.66 \sqrt{f'_c} b_w d = 56.09\text{kN}$
 - $V_{s,req} < V_{c2} \rightarrow \text{O.K}$
 - $A_{v,min1}/s$
 - $A_{v,min} / s = \min [A_{v,min1} / s , A_{v,min2} / s] = 0.105\text{mm}^2/\text{mm}$
 - $A_{v,req0} / s = 0.398\text{mm}^2/\text{mm}$
 - $A_{v,req} / s = \max [A_{v,min} / s , A_{v,req0} / s] = 0.398\text{mm}^2/\text{mm}$
- (3) Calculate shear strength by stirrup
- $N_{leg} = 2$ $A_{v1} = 70.97\text{mm}^2$ (#3)
 - $\phi V_s = 42.07\text{kN}$
- (4) Calculate ratio of shear capacity
- $\phi V_n = \phi V_c + \phi V_s = 52.90\text{kN}$
 - $V_u / \phi V_n = 0.556 \rightarrow \text{O.K}$
- (5) Calculate spacing limits for reinforcement
- $s_{max,0} = \min [d/2, 600\text{mm}] = 77.86\text{mm}$
 - $s_{req} = 357\text{mm}$
 - $s_{max} = \min [s_{max,0} , s_{req}] = 77.86\text{mm}$
 - $s = 76.20\text{mm} < s_{max} = 77.86\text{mm} \rightarrow \text{O.K}$

10. Check Rebar Diameter by Seismic Provision

- (1) Check main bar diameter
- $d_{main,limit} = 0.000\text{mm}$
 - $d_{main} = \min(d_{top} , d_{bot}) = 9.525\text{mm}$
 - $d_{main} < d_{main,limit} \rightarrow \text{O.K}$

■ MEMBER NAME : DINTEL 10X15 [Section : END(I)]

1. General Information

- (1) Design Code : NSR-10
- (2) Unit System : N, mm

2. Material

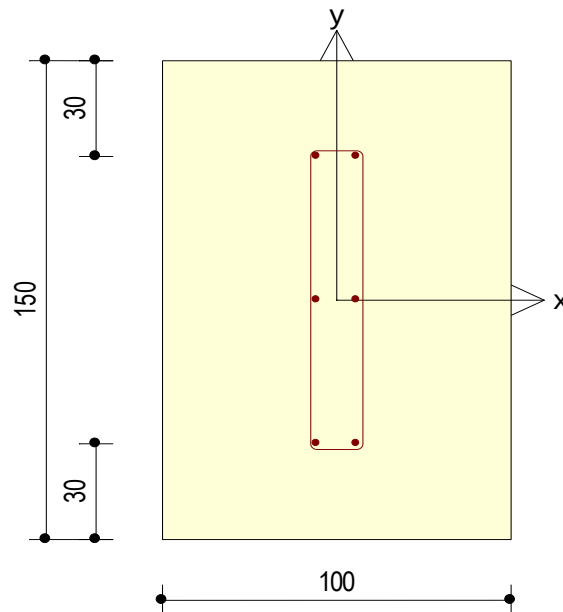
- (1) F'_c : 20.68MPa
- (2) F_y : 400MPa
- (3) F_{ys} : 400MPa

3. Section

- (1) Section Size : 100 x 150mm (R-Section)
- (2) Cover : 30.00mm
- (3) Compression : Not Considered
- (4) Splicing Limit : 50%
- (5) Span : 0.000m

4. Seismic Design Parameters

- (1) Special provisions for seismic design is applied.
- (2) Frame Type : DMI(Minimum Energy Dissipation)



5. Moments and Forces

- (1) $M_{u,top}$: 0.000kN·m
- (2) $M_{u,bottom}$: 0.000kN·m
- (3) V_u : 9.807kN

6. Reinforcement

- (1) Top Bar : 2-#3 ($A_s = 142\text{mm}^2$)
 - Layer 1 : 2 EA ($C_c = 44.29\text{mm}$)

- (2) Bot Bar : 2-#3 ($A_s = 142\text{mm}^2$)
- Layer 1 : 2 EA ($C_c = 44.29\text{mm}$)
- (3) Stirrup : 2-#3@50.80 ($A_s = 142\text{mm}^2$)
- (4) Skin Bar : 1-#3 ($A_s = 70.97\text{mm}^2$) (at Tension Region)

7. Check Bending Moment Capacity (Positive)

- (1) Calculate design parameter
 - $\beta_1 = 0.85 - 0.007 (f'_c - 28) = 0.850$
- (2) Check space of rebar
 - Moment is zero. Skipped.
- (3) Calculate required ratio of reinforcement
 - Moment is zero. Skipped.
- (4) Calculate moment capacity
 - Moment is zero. Skipped.

8. Check Bending Moment Capacity (Negative)

- (1) Calculate design parameter
 - $\beta_1 = 0.85 - 0.007 (f'_c - 28) = 0.850$
- (2) Check space of rebar
 - Moment is zero. Skipped.
- (3) Calculate required ratio of reinforcement
 - Moment is zero. Skipped.
- (4) Calculate moment capacity
 - Moment is zero. Skipped.

9. Check Shear Capacity

- (1) Calculate shear strength by concrete
 - $\phi = 0.750$ $d = 106\text{mm}$
 - $\phi V_c = \phi 0.17 \sqrt{f'_c} b_w d = 6.130\text{kN}$
 - $V_u > \phi V_c \rightarrow$ Shear reinforcement is required
- (2) Calculate required shear strength by shear reinforcement
 - $V_{s,req} = (V_u - \phi V_c) / \phi = 4.902\text{kN}$
 - $V_{c1} = 0.33 \sqrt{f'_c} b_w d = 15.87\text{kN}$ Refer to [11.4.5.3]
 - $V_{c2} = 0.66 \sqrt{f'_c} b_w d = 31.73\text{kN}$
 - $V_{s,req} < V_{c2} \rightarrow \text{O.K}$
 - $A_{v,min1/s}$ $A_{v,min2/s}$
 - $A_{v,min} / s = \min [A_{v,min1} / s , A_{v,min2} / s] = 0.0875\text{mm}^2/\text{mm}$
 - $A_{v,req0} / s = 0.116\text{mm}^2/\text{mm}$
 - $A_{v,req} / s = \max [A_{v,min} / s , A_{v,req0} / s] = 0.116\text{mm}^2/\text{mm}$
- (3) Calculate shear strength by stirrup
 - $N_{leg} = 2$ $A_{v1} = 70.97\text{mm}^2$ (#3)
 - $\phi V_s = 23.80\text{kN}$
- (4) Calculate ratio of shear capacity
 - $\phi V_n = \phi V_c + \phi V_s = 29.93\text{kN}$
 - $V_u / \phi V_n = 0.328 \rightarrow \text{O.K}$
- (5) Calculate spacing limits for reinforcement
 - $s_{max,0} = \min [d/2, 600\text{mm}] = 52.86\text{mm}$
 - $s_{req} = 1,224\text{mm}$
 - $s_{max} = \min [s_{max,0} , s_{req}] = 52.86\text{mm}$

- $s = 50.80\text{mm} < s_{\max} = 52.86\text{mm} \rightarrow \text{O.K}$

10. Check Rebar Diameter by Seismic Provision

- (1) Check main bar diameter
 - $d_{\text{main.limit}} = 0.000\text{mm}$
 - $d_{\text{main}} = \min(d_{\text{top}} , d_{\text{bot}}) = 9.525\text{mm}$
 - $d_{\text{main}} < d_{\text{main.limit}} \rightarrow \text{O.K}$

■ MEMBER NAME : DINTEL 10X15 [Section : MIDDLE]

1. General Information

- (1) Design Code : NSR-10
- (2) Unit System : N, mm

2. Material

- (1) F'_c : 20.68MPa
- (2) F_y : 400MPa
- (3) F_{ys} : 400MPa

3. Section

- (1) Section Size : 100 x 150mm (R-Section)
- (2) Cover : 30.00mm
- (3) Compression : Not Considered
- (4) Splicing Limit : 50%
- (5) Span : 0.000m

4. Seismic Design Parameters

- (1) Special provisions for seismic design is applied.
- (2) Frame Type : DMI(Minimum Energy Dissipation)

5. Moments and Forces

- (1) $M_{u,\text{top}}$: 0.392kN·m
- (2) $M_{u,\text{bottom}}$: 0.000kN·m
- (3) V_u : 9.807kN

6. Reinforcement

- (1) Top Bar : 2-#3 ($A_s = 142\text{mm}^2$)
 - Layer 1 : 2 EA ($C_c = 44.29\text{mm}$)
- (2) Bot Bar : 2-#3 ($A_s = 142\text{mm}^2$)
 - Layer 1 : 2 EA ($C_c = 44.29\text{mm}$)
- (3) Stirrup : 2-#3@50.80 ($A_s = 142\text{mm}^2$)
- (4) Skin Bar : 1-#3 ($A_s = 70.97\text{mm}^2$) (at Tension Region)

7. Check Bending Moment Capacity (Positive)

- (1) Calculate design parameter
 - $\beta_1 = 0.85 - 0.007 (f'_c - 28) = 0.850$
- (2) Check space of rebar
 - Moment is zero. Skipped.
- (3) Calculate required ratio of reinforcement
 - Moment is zero. Skipped.
- (4) Calculate moment capacity

- Moment is zero. Skipped.

8. Check Bending Moment Capacity (Negative)

(1) Calculate design parameter

- $\beta_1 = 0.85 - 0.007 (f'_c - 28) = 0.850$

(2) Check space of rebar

- $s_{max1} \quad s_{max2}$
- $s_{max} = \min (s_{max1} , s_{max2}) = 300\text{mm}, \quad N_{req} = 2$
- $s = 11.43 < 300\text{mm} \rightarrow \text{O.K}$

(3) Calculate required ratio of reinforcement

- $\rho_{min.11} \quad \rho_{min.12}$
- $\rho_{min.1} = \max (\rho_{min.11} , \rho_{min.12}) = 0.0035$
- $\rho_{min.2} = 0.0013$
- $\rho_{min} = \min (\rho_{min1} , \rho_{min2}) = 0.0013$
- $\rho_{et} = 0.0160$
- $\rho_{max} = \rho_{et} = 0.0160$

(4) Check ratio of tensile reinforcement

- $\rho = 0.0134$
- $\rho_{min} < \rho < \rho_{max} \rightarrow \text{O.K}$

(5) Calculate moment capacity

- $a = 32.29\text{mm}$
- $\phi = 0.900$
- $M_n = A_s f_y (d - a/2) = 5.085\text{kN}\cdot\text{m}$
- $\phi M_n = 4.577\text{kN}\cdot\text{m}$

(6) Calculate ratio of moment capacity

- $M_u / \phi M_n = 0.0857 \rightarrow \text{O.K}$

9. Check Shear Capacity

(1) Calculate shear strength by concrete

- $\phi = 0.750 \quad d = 106\text{mm}$
- $\phi V_c = \phi 0.17 \sqrt{f'_c} b_w d = 6.130\text{kN}$
- $V_u > \phi V_c \rightarrow \text{Shear reinforcement is required}$

(2) Calculate required shear strength by shear reinforcement

- $V_{s.req} = (V_u - \phi V_c) / \phi = 4.902\text{kN}$
- $V_{c1} = 0.33 \sqrt{f'_c} b_w d = 15.87\text{kN}$ Refer to [11.4.5.3]
- $V_{c2} = 0.66 \sqrt{f'_c} b_w d = 31.73\text{kN}$
- $V_{s.req} < V_{c2} \rightarrow \text{O.K}$

- $A_{v.min1/s} \quad A_{v.min2/s}$
- $A_{v.min} / s = \min [A_{v.min1} / s , A_{v.min2} / s] = 0.0875\text{mm}^2/\text{mm}$
- $A_{v.req0} / s = 0.116\text{mm}^2/\text{mm}$
- $A_{v.req} / s = \max [A_{v.min} / s , A_{v.req0} / s] = 0.116\text{mm}^2/\text{mm}$

(3) Calculate shear strength by stirrup

- $N_{leg} = 2 \quad A_{v1} = 70.97\text{mm}^2 (\#3)$
- $\phi V_s = 23.80\text{kN}$

(4) Calculate ratio of shear capacity

- $\phi V_n = \phi V_c + \phi V_s = 29.93\text{kN}$
- $V_u / \phi V_n = 0.328 \rightarrow \text{O.K}$

(5) Calculate spacing limits for reinforcement

- $s_{max,0} = \min [d/2, 600\text{mm}] = 52.86\text{mm}$
- $s_{req} = 1,224\text{mm}$
- $s_{max} = \min [s_{max,0}, s_{req}] = 52.86\text{mm}$
- $s = 50.80\text{mm} < s_{max} = 52.86\text{mm} \rightarrow \text{O.K}$

10. Check Rebar Diameter by Seismic Provision

- (1) Check main bar diameter
 - $d_{main,limit} = 0.000\text{mm}$
 - $d_{main} = \min(d_{top}, d_{bot}) = 9.525\text{mm}$
 - $d_{main} < d_{main,limit} \rightarrow \text{O.K}$

■ MEMBER NAME : DINTEL 10X15 [Section : END(J)]

1. General Information

- (1) Design Code : NSR-10
- (2) Unit System : N, mm

2. Material

- (1) F'_c : 20.68MPa
- (2) F_y : 400MPa
- (3) F_{ys} : 400MPa

3. Section

- (1) Section Size : 100 x 150mm (R-Section)
- (2) Cover : 30.00mm
- (3) Compression : Not Considered
- (4) Splicing Limit : 50%
- (5) Span : 0.000m

4. Seismic Design Parameters

- (1) Special provisions for seismic design is applied.
- (2) Frame Type : DMI(Minimum Energy Dissipation)

5. Moments and Forces

- (1) $M_{u,top}$: 0.000kN·m
- (2) $M_{u,bottom}$: 0.000kN·m
- (3) V_u : 9.807kN

6. Reinforcement

- (1) Top Bar : 2-#3 ($A_s = 142\text{mm}^2$)
 - Layer 1 : 2 EA ($C_c = 44.29\text{mm}$)
- (2) Bot Bar : 2-#3 ($A_s = 142\text{mm}^2$)
 - Layer 1 : 2 EA ($C_c = 44.29\text{mm}$)
- (3) Stirrup : 2-#3@50.80 ($A_s = 142\text{mm}^2$)
- (4) Skin Bar : 1-#3 ($A_s = 70.97\text{mm}^2$) (at Tension Region)

7. Check Bending Moment Capacity (Positive)

- (1) Calculate design parameter
 - $\beta_1 = 0.85 - 0.007 (f'_c - 28) = 0.850$
- (2) Check space of rebar
 - Moment is zero. Skipped.

- (3) Calculate required ratio of reinforcement
 - Moment is zero. Skipped.
- (4) Calculate moment capacity
 - Moment is zero. Skipped.

8. Check Bending Moment Capacity (Negative)

- (1) Calculate design parameter
 - $\beta_1 = 0.85 - 0.007 (f'_c - 28) = 0.850$
- (2) Check space of rebar
 - Moment is zero. Skipped.
- (3) Calculate required ratio of reinforcement
 - Moment is zero. Skipped.
- (4) Calculate moment capacity
 - Moment is zero. Skipped.

9. Check Shear Capacity

- (1) Calculate shear strength by concrete
 - $\phi = 0.750$ $d = 106\text{mm}$
 - $\phi V_c = \phi 0.17 \sqrt{f'_c} b_w d = 6.130\text{kN}$
 - $V_u > \phi V_c \rightarrow$ Shear reinforcement is required
- (2) Calculate required shear strength by shear reinforcement
 - $V_{s,req} = (V_u - \phi V_c) / \phi = 4.902\text{kN}$
 - $V_{c1} = 0.33 \sqrt{f'_c} b_w d = 15.87\text{kN}$ Refer to [11.4.5.3]
 - $V_{c2} = 0.66 \sqrt{f'_c} b_w d = 31.73\text{kN}$
 - $V_{s,req} < V_{c2} \rightarrow \text{O.K}$
 - $A_{v,min1}/s$ $A_{v,min2}/s$
 - $A_{v,min} / s = \min [A_{v,min1} / s , A_{v,min2} / s] = 0.0875\text{mm}^2/\text{mm}$
 - $A_{v,req0} / s = 0.116\text{mm}^2/\text{mm}$
 - $A_{v,req} / s = \max [A_{v,min} / s , A_{v,req0} / s] = 0.116\text{mm}^2/\text{mm}$
- (3) Calculate shear strength by stirrup
 - $N_{leg} = 2$ $A_{v1} = 70.97\text{mm}^2$ (#3)
 - $\phi V_s = 23.80\text{kN}$
- (4) Calculate ratio of shear capacity
 - $\phi V_n = \phi V_c + \phi V_s = 29.93\text{kN}$
 - $V_u / \phi V_n = 0.328 \rightarrow \text{O.K}$
- (5) Calculate spacing limits for reinforcement
 - $s_{max,0} = \min [d/2, 600\text{mm}] = 52.86\text{mm}$
 - $s_{req} = 1,224\text{mm}$
 - $s_{max} = \min [s_{max,0} , s_{req}] = 52.86\text{mm}$
 - $s = 50.80\text{mm} < s_{max} = 52.86\text{mm} \rightarrow \text{O.K}$

10. Check Rebar Diameter by Seismic Provision

- (1) Check main bar diameter
 - $d_{main,limit} = 0.000\text{mm}$
 - $d_{main} = \min(d_{top} , d_{bot}) = 9.525\text{mm}$
 - $d_{main} < d_{main,limit} \rightarrow \text{O.K}$