ANEXO 11. DISEÑO DE ELEMENTOS NO ESTRUCTURALES

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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

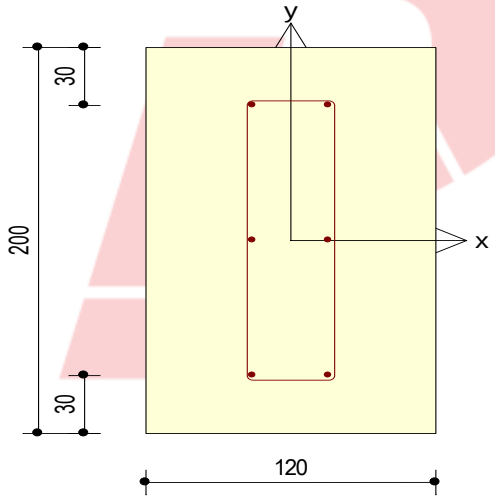
(1) F'_c : 20.68MPa
(2) F_y : 400MPa
(3) F_{ys} : 400MPa

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 = 142mm²)
- Layer 1 : 2 EA (C_c = 44.29mm)

(2) Bot Bar : 2-#3 (A_s = 142mm²)
- Layer 1 : 2 EA (C_c = 44.29mm)

(3) Stirrup : 2-#3@76.20 (A_s = 142mm²)
(4) Skin Bar : 1-#3 (A_s = 70.97mm²) (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

- $\phi = 0.750$ $d = 156mm$
- $\phi V_c = \phi\ 0.17 \sqrt{f'_c}\ b_w\ d = 10.84kN$
- $V_u > \phi V_c \rightarrow$ Shear reinforcement is required

(2) Calculate required shear strength by shear reinforcement

- $V_{s.req} = (V_u - \phi V_c) / \phi = 24.78kN$
- $V_{c1} = 0.33 \sqrt{f'_c}\ b_w\ d = 28.04kN$ Refer to [11.4.5.3]
- $V_{c2} = 0.66 \sqrt{f'_c}\ b_w\ d = 56.09kN$
- $V_{s.req} < V_{c2} \rightarrow$ O.K
- $A_{v.min1/s}$
- $A_{v.min} /s = \min [A_{v.min1} /s , A_{v.min2} /s] = 0.105mm^2/mm$
- $A_{v.req0} /s = 0.398mm^2/mm$
- $A_{v.req} /s = \max [A_{v.min} /s , A_{v.req0} /s] = 0.398mm^2/mm$

(3) Calculate shear strength by stirrup

- $N_{leg} = 2$ $A_{v1} = 70.97mm^2$ (#3)
- $\phi V_s = 42.07kN$

(4) Calculate ratio of shear capacity

- $\phi V_n = \phi V_c + \phi V_s = 52.90kN$
- $V_u / \phi V_n = 0.556 \rightarrow$ O.K

(5) Calculate spacing limits for reinforcement

- $s_{max.0} = \min [d/2, 600mm] = 77.86mm$
- $s_{req} = 357mm$
- $s_{max} = \min [s_{max.0} , s_{req}] = 77.86mm$
- $s = 76.20mm < s_{max} = 77.86mm \rightarrow$ O.K

10. Check Rebar Diameter by Seismic Provision

(1) Check main bar diameter

- $d_{main.limit}$ = 0.000mm
- d_{main} = min(d_{top} , d_{bot}) = 9.525mm
- $d_{main} < d_{main.limit}$ → 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 = 142mm²)
- Layer 1 : 2 EA (C_c = 44.29mm)

(2) Bot Bar : 2-#3 (A_s = 142mm²)
- Layer 1 : 2 EA (C_c = 44.29mm)

(3) Stirrup : 2-#3@76.20 (A_s = 142mm²)
(4) Skin Bar : 1-#3 (A_s = 70.97mm²) (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}
- $s_{max} = \min (s_{max1} , s_{max2}) = 300mm,$ $N_{req} = 2$
- $s = 31.43 < 300mm \rightarrow$ 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

- $\rho = 0.0076$
- $\rho_{min} < \rho < \rho_{max} \rightarrow$ O.K

(5) Calculate moment capacity

- $a = 26.91mm$
- $\phi = 0.900$
- $M_n = A_s f_y (d - a/2) = 8.077kN\cdot m$
- $\phi M_n = 7.269kN\cdot m$

(6) Calculate ratio of moment capacity

- $M_u / \phi M_n = 0.189 \rightarrow$ O.K

10. Check Shear Capacity

(1) Calculate shear strength by concrete

- $\phi = 0.750$ $d = 156mm$
- $\phi V_c = \phi\ 0.17 \sqrt{f'_c}\ b_w\ d = 10.84kN$
- $V_u > \phi V_c \rightarrow$ Shear reinforcement is required

(2) Calculate required shear strength by shear reinforcement

- $V_{s.req} = (V_u - \phi V_c) / \phi = 24.78kN$
- $V_{c1} = 0.33 \sqrt{f'_c}\ b_w\ d = 28.04kN$ Refer to [11.4.5.3]
- $V_{c2} = 0.66 \sqrt{f'_c}\ b_w\ d = 56.09kN$
- $V_{s.req} < V_{c2} \rightarrow$ O.K
- $A_{v.min1/s}$
- $A_{v.min} / s = \min [A_{v.min1} / s , A_{v.min2} / s] = 0.105mm^2/mm$
- $A_{v.req0} / s = 0.398mm^2/mm$

- $A_{v.req}/s = \max [A_{v.min}/s , A_{v.req0}/s] = 0.398mm^2/mm$

(3) Calculate shear strength by stirrup

- $N_{leg} = 2$ $A_{v1} = 70.97mm^2$ (#3)
- $øV_s$ = **¡Error!** = 42.07kN

(4) Calculate ratio of shear capacity

- $øV_n = øV_c + øV_s = 52.90kN$
- $V_u / øV_n = 0.556$ → O.K

(5) Calculate spacing limits for reinforcement

- $s_{max.0} = \min [d/2, 600mm] = 77.86mm$
- s_{req} = **¡Error!** = 357mm
- $s_{max} = \min [s_{max.0} , s_{req}] = 77.86mm$
- $s = 76.20mm < s_{max} = 77.86mm$ → O.K

11. Check Rebar Diameter by Seismic Provision

(1) Check main bar diameter

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

- $I_g = 80,000,000mm^4$
- $n = E_s / E_c = 9.356$
- $f_r = 0.62\sqrt{f'_c} = 2.820MPa$
- $M_{cr} = 2.256kN·m$

(4) Calculate positive moment

- $M_D = 3.065kN·m$
- $M_L = 0.000kN·m$
- $M_{D+L} = 3.065kN·m$
- $M_{SUS.} = M_D + 0.50M_L = 3.065kN·m$

(5) Calculate inertia of moment for positive section

- $I_{cr} = 19,847,582mm^4$
- $I_{e.D} = 43,838,485mm^4$
- $I_{e.D} = 43,838,485mm^4$
- $I_{e.D+L} = 43,838,485mm^4$
- $I_{e.D+L} = 43,838,485mm^4$
- $I_{e.SUS.} = 43,838,485mm^4$
- $I_{e.SUS.} = 43,838,485mm^4$

(6) Calculate effective inertia of moment

- $I_{e.D} = I_m = 43,838,485mm^4$
- $I_{e.D+L} = I_m = 43,838,485mm^4$

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

(7) Calculate deflection

- K = 1.000
- $\delta_{i.D}$ = 0.341mm
- $\delta_{i.D+L}$ = 0.341mm
- $\delta_{i.SUS}$ = 0.341mm
- $\delta_{i.L} = \delta_{i.D+L} - \delta_{i.D}$ = 0.000mm
- 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 = 142mm²)
- Layer 1 : 2 EA (C_c = 44.29mm)

(2) Bot Bar : 2-#3 (A_s = 142mm²)
- Layer 1 : 2 EA (C_c = 44.29mm)

(3) Stirrup : 2-#3@76.20 (A_s = 142mm²)
(4) Skin Bar : 1-#3 (A_s = 70.97mm²) (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

- $\phi = 0.750$ $d = 156mm$
- $\phi V_c = \phi\ 0.17 \sqrt{f'_c}\ b_w\ d = 10.84kN$
- $V_u > \phi V_c \rightarrow$ Shear reinforcement is required

(2) Calculate required shear strength by shear reinforcement

- $V_{s.req} = (V_u - \phi V_c) / \phi = 24.78kN$
- $V_{c1} = 0.33 \sqrt{f'_c}\ b_w\ d = 28.04kN$ Refer to [11.4.5.3]
- $V_{c2} = 0.66 \sqrt{f'_c}\ b_w\ d = 56.09kN$
- $V_{s.req} < V_{c2} \rightarrow$ O.K
- $A_{v.min1/s}$
- $A_{v.min} /s = min [A_{v.min1} /s , A_{v.min2} /s] = 0.105mm^2/mm$
- $A_{v.req0} /s = 0.398mm^2/mm$
- $A_{v.req} /s = max [A_{v.min} /s , A_{v.req0} /s] = 0.398mm^2/mm$

(3) Calculate shear strength by stirrup

- $N_{leg} = 2$ $A_{v1} = 70.97mm^2$ (#3)
- $\phi V_s = 42.07kN$

(4) Calculate ratio of shear capacity

- $\phi V_n = \phi V_c + \phi V_s = 52.90kN$
- $V_u / \phi V_n = 0.556 \rightarrow$ O.K

(5) Calculate spacing limits for reinforcement

- $s_{max.0} = min [d/2, 600mm] = 77.86mm$
- $s_{req} = 357mm$
- $s_{max} = min [s_{max.0} , s_{req}] = 77.86mm$
- $s = 76.20mm < s_{max} = 77.86mm \rightarrow$ O.K

10. Check Rebar Diameter by Seismic Provision

(1) Check main bar diameter

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

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

1. General Information

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

2. Material

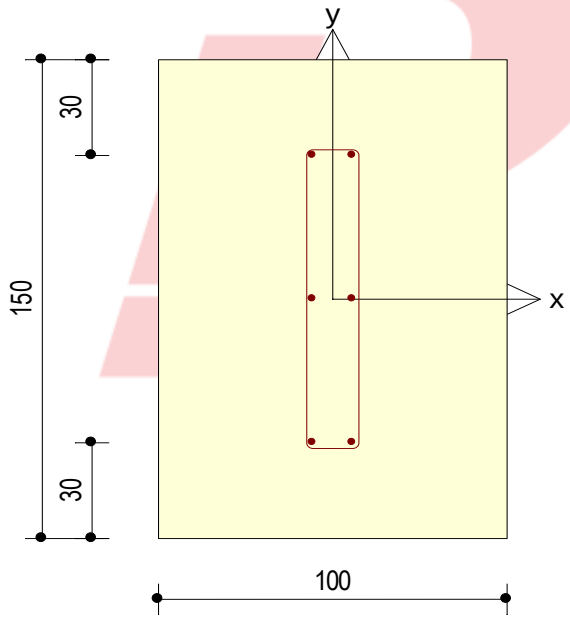
(1) F'_c : 20.68MPa
(2) F_y : 400MPa
(3) F_{ys} : 400MPa

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 = 142mm²)
- Layer 1 : 2 EA (C_c = 44.29mm)

(2) Bot Bar : 2-#3 (A_s = 142mm²)
- Layer 1 : 2 EA (C_c = 44.29mm)

(3) Stirrup : 2-#3@50.80 (A_s = 142mm²)
(4) Skin Bar : 1-#3 (A_s = 70.97mm²) (at Tension Region)

7. Check Bending Moment Capacity (Positive)

(1) Calculate design parameter
- β_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
- β_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
- ø = 0.750 d = 106mm
- $øV_c = ø\ 0.17 \sqrt{f'_c}\ b_w\ d$ = 6.130kN
- $V_u > øV_c$ → Shear reinforcement is required

(2) Calculate required shear strength by shear reinforcement
- $V_{s.req} = (V_u - øV_c) / ø$ = 4.902kN
- $V_{c1} = 0.33 \sqrt{f'_c}\ b_w\ d$ = 15.87kN Refer to [11.4.5.3]
- $V_{c2} = 0.66 \sqrt{f'_c}\ b_w\ d$ = 31.73kN
- $V_{s.req} < V_{c2}$ → O.K
- $A_{v.min1/s}$ $A_{v.min2/s}$
- $A_{v.min}/s$ = min [$A_{v.min1}/s$, $A_{v.min2}/s$] = 0.0875mm²/mm
- $A_{v.req0}/s$ = 0.116mm²/mm
- $A_{v.req}/s$ = max [$A_{v.min}/s$, $A_{v.req0}/s$] = 0.116mm²/mm

(3) Calculate shear strength by stirrup
- N_{leg} = 2 A_{v1} = 70.97mm² (#3)
- $øV_s$ = 23.80kN

(4) Calculate ratio of shear capacity
- $øV_n = øV_c + øV_s$ = 29.93kN
- $V_u / øV_n$ = 0.328 → O.K

(5) Calculate spacing limits for reinforcement
- $s_{max.0}$ = min [d/2, 600mm] = 52.86mm
- s_{req} = 1,224mm
- s_{max} = min [$s_{max.0}$, s_{req}] = 52.86mm

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

10. Check Rebar Diameter by Seismic Provision

(1) Check main bar diameter

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

■ 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) $M_{u.top}$: 0.392kN·m
(2) $M_{u.bottom}$: 0.000kN·m
(3) V_u : 9.807kN

6. Reinforcement

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

(2) Bot Bar : 2-#3 ($A_s = 142mm^2$)
- Layer 1 : 2 EA ($C_c = 44.29mm$)

(3) Stirrup : 2-#3@50.80 ($A_s = 142mm^2$)
(4) Skin Bar : 1-#3 ($A_s = 70.97mm^2$) (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} s_{max2}
- $s_{max} = \min (s_{max1} , s_{max2}) = 300mm,$ $N_{req} = 2$
- $s = 11.43 < 300mm \rightarrow$ O.K

(3) Calculate required ratio of reinforcement

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

(4) Check ratio of tensile reinforcement

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

(5) Calculate moment capacity

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

(6) Calculate ratio of moment capacity

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

9. Check Shear Capacity

(1) Calculate shear strength by concrete

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

(2) Calculate required shear strength by shear reinforcement

- $V_{s.req} = (V_u - \phi V_c) / \phi = 4.902kN$
- $V_{c1} = 0.33 \sqrt{f'_c}\ b_w\ d = 15.87kN$ Refer to [11.4.5.3]
- $V_{c2} = 0.66 \sqrt{f'_c}\ b_w\ d = 31.73kN$
- $V_{s.req} < V_{c2} \rightarrow$ O.K
- $A_{v.min1/s}$ $A_{v.min2/s}$
- $A_{v.min} /s = \min [A_{v.min1} /s , A_{v.min2} /s] = 0.0875mm^2/mm$
- $A_{v.req0} /s = 0.116mm^2/mm$
- $A_{v.req} /s = \max [A_{v.min} /s , A_{v.req0} /s] = 0.116mm^2/mm$

(3) Calculate shear strength by stirrup

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

(4) Calculate ratio of shear capacity

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

(5) Calculate spacing limits for reinforcement

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

10. Check Rebar Diameter by Seismic Provision

(1) Check main bar diameter

- $d_{main.limit}$ = 0.000mm
- d_{main} = min(d_{top} , d_{bot}) = 9.525mm
- d_{main} < $d_{main.limit}$ → 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 = 142mm²)
- Layer 1 : 2 EA (C_c = 44.29mm)

(2) Bot Bar : 2-#3 (A_s = 142mm²)
- Layer 1 : 2 EA (C_c = 44.29mm)

(3) Stirrup : 2-#3@50.80 (A_s = 142mm²)
(4) Skin Bar : 1-#3 (A_s = 70.97mm²) (at Tension Region)

7. Check Bending Moment Capacity (Positive)

(1) Calculate design parameter
- β_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

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

(2) Calculate required shear strength by shear reinforcement

- $V_{s.req} = (V_u - \phi V_c) / \phi = 4.902kN$
- $V_{c1} = 0.33 \sqrt{f'_c}\ b_w\ d = 15.87kN$ Refer to [11.4.5.3]
- $V_{c2} = 0.66 \sqrt{f'_c}\ b_w\ d = 31.73kN$
- $V_{s.req} < V_{c2} \rightarrow$ O.K
- $A_{v.min1/s}$ $A_{v.min2/s}$
- $A_{v.min} /s = min [A_{v.min1} /s , A_{v.min2} /s] = 0.0875mm^2/mm$
- $A_{v.req0} /s = 0.116mm^2/mm$
- $A_{v.req} /s = max [A_{v.min} /s , A_{v.req0} /s] = 0.116mm^2/mm$

(3) Calculate shear strength by stirrup

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

(4) Calculate ratio of shear capacity

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

(5) Calculate spacing limits for reinforcement

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

10. Check Rebar Diameter by Seisimic Provision

(1) Check main bar diameter

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