# DAFTAR LAMPIRAN

**L.1 Hasil *Output* SAP 2000**

**L.2 Gambar Struktur Tangki Air**

**L.3 Manual dari VSL**

**L.4 Lendutan Ijin Maksimum**

# LAMPIRAN 1

# HASIL *OUTPUT* SAP 2000

## L1.1 Hasil *Output* dari SAP 2000 dengan Beban Air 7 m

Hasil *ouput* nilai momen dan tegangan yang bekerja pada dinding tangki dengan beban air setinggi 7 m yang digunakan dalam perhitungan sebelumnya dapat dilihat pada Tabel L1.1.

**Tabel L1.1 Hasil *Output Element Forces-Area Shell* dari Sap 2000 dengan Beban Air 7 m**

| Area | Joint | OutputCase | CaseType | F11 N/mm | F22 N/mm | M11 N-mm/mm | M22 N-mm/mm |
|---|---|---|---|---|---|---|---|
| 19 | 39 | DEAD | LinStatic | -9.41 | -47.05 | 108.43 | 542.15 |
| 19 | 40 | DEAD | LinStatic | -7.64 | -46.7 | 3.88 | 19.41 |
| 19 | 39 | COMB1 | Combination | -13.17 | -65.87 | 151.8 | 759.01 |
| 19 | 40 | COMB1 | Combination | -10.7 | -65.38 | 5.43 | 27.17 |
| 19 | 39 | COMB2 | Combination | -19.61 | -98.06 | 20099.6 | 100497.99 |
| 19 | 40 | COMB2 | Combination | 304.74 | -33.19 | 325.16 | 1625.82 |
| 19 | 39 | COMB3 | Combination | -14.01 | -70.04 | 14356.86 | 71784.28 |
| 19 | 40 | COMB3 | Combination | 217.67 | -23.71 | 232.26 | 1161.3 |
| 20 | 39 | DEAD | LinStatic | -9.41 | -47.05 | 108.43 | 542.15 |
| 20 | 40 | DEAD | LinStatic | -7.64 | -46.7 | 3.88 | 19.41 |
| 20 | 39 | COMB1 | Combination | -13.17 | -65.87 | 151.8 | 759.01 |
| 20 | 40 | COMB1 | Combination | -10.7 | -65.38 | 5.43 | 27.17 |
| 20 | 39 | COMB2 | Combination | -19.61 | -98.06 | 20099.6 | 100497.99 |
| 20 | 40 | COMB2 | Combination | 304.74 | -33.19 | 325.16 | 1625.82 |
| 20 | 39 | COMB3 | Combination | -14.01 | -70.04 | 14356.86 | 71784.28 |
| 20 | 40 | COMB3 | Combination | 217.67 | -23.71 | 232.26 | 1161.3 |
| 119 | 40 | DEAD | LinStatic | -6.48 | -40.88 | 3.88 | 19.4 |
| 119 | 220 | DEAD | LinStatic | -3.97 | -40.37 | -31.42 | -157.09 |
| 119 | 40 | COMB1 | Combination | -9.07 | -57.23 | 5.43 | 27.15 |
| 119 | 220 | COMB1 | Combination | -5.56 | -56.52 | -43.98 | -219.92 |
| 119 | 40 | COMB2 | Combination | 291.08 | -101.48 | 323.77 | 1618.85 |
| 119 | 220 | COMB2 | Combination | 737.17 | -12.27 | -6188.27 | -30941.36 |
| 119 | 40 | COMB3 | Combination | 207.92 | -72.49 | 231.26 | 1156.32 |
| 119 | 220 | COMB3 | Combination | 526.55 | -8.76 | -4420.19 | -22100.97 |
| 120 | 40 | DEAD | LinStatic | -6.48 | -40.88 | 3.88 | 19.4 |

**Tabel L1.1 Hasil *Output Element Forces-Area Shell* dari Sap 2000 dengan Beban Air 7 m (lanjutan)**

| Area | Joint | OutputCase | CaseType | F11 N/mm | F22 N/mm | M11 N-mm/mm | M22 N-mm/mm |
|---|---|---|---|---|---|---|---|
| 120 | 220 | DEAD | LinStatic | -3.97 | -40.37 | -31.42 | -157.09 |
| 120 | 40 | COMB1 | Combination | -9.07 | -57.23 | 5.43 | 27.15 |
| 120 | 220 | COMB1 | Combination | -5.56 | -56.52 | -43.98 | -219.92 |
| 120 | 40 | COMB2 | Combination | 291.08 | -101.48 | 323.77 | 1618.85 |
| 120 | 220 | COMB2 | Combination | 737.17 | -12.27 | -6188.27 | -30941.36 |
| 120 | 40 | COMB3 | Combination | 207.92 | -72.49 | 231.26 | 1156.32 |
| 120 | 220 | COMB3 | Combination | 526.55 | -8.76 | -4420.19 | -22100.97 |
| 219 | 220 | DEAD | LinStatic | -2.8 | -34.5 | -31.35 | -156.73 |
| 219 | 320 | DEAD | LinStatic | -1.51 | -34.25 | -30.7 | -153.51 |
| 219 | 220 | COMB1 | Combination | -3.92 | -48.31 | -43.88 | -219.42 |
| 219 | 320 | COMB1 | Combination | -2.11 | -47.94 | -42.98 | -214.92 |
| 219 | 220 | COMB2 | Combination | 725.92 | -68.51 | -6176.14 | -30880.72 |
| 219 | 320 | COMB2 | Combination | 929.74 | -27.74 | -5864.66 | -29323.28 |
| 219 | 220 | COMB3 | Combination | 518.52 | -48.93 | -4411.53 | -22057.66 |
| 219 | 320 | COMB3 | Combination | 664.1 | -19.82 | -4189.04 | -20945.2 |
| 220 | 220 | DEAD | LinStatic | -2.8 | -34.5 | -31.35 | -156.73 |
| 220 | 320 | DEAD | LinStatic | -1.51 | -34.25 | -30.7 | -153.51 |
| 220 | 220 | COMB1 | Combination | -3.92 | -48.31 | -43.88 | -219.42 |
| 220 | 320 | COMB1 | Combination | -2.11 | -47.94 | -42.98 | -214.92 |
| 220 | 220 | COMB2 | Combination | 725.92 | -68.51 | -6176.14 | -30880.72 |
| 220 | 320 | COMB2 | Combination | 929.74 | -27.74 | -5864.66 | -29323.28 |
| 220 | 220 | COMB3 | Combination | 518.52 | -48.93 | -4411.53 | -22057.66 |
| 220 | 320 | COMB3 | Combination | 664.1 | -19.82 | -4189.04 | -20945.2 |
| 319 | 320 | DEAD | LinStatic | -0.28 | -28.12 | -30.66 | -153.3 |
| 319 | 420 | DEAD | LinStatic | -0.38 | -28.13 | -18.65 | -93.25 |
| 319 | 320 | COMB1 | Combination | -0.4 | -39.36 | -42.92 | -214.62 |
| 319 | 420 | COMB1 | Combination | -0.53 | -39.39 | -26.11 | -130.55 |
| 319 | 320 | COMB2 | Combination | 928.62 | -33.32 | -5858.54 | -29292.69 |
| 319 | 420 | COMB2 | Combination | 868.11 | -45.43 | -3401.26 | -17006.32 |
| 319 | 320 | COMB3 | Combination | 663.3 | -23.8 | -4184.67 | -20923.35 |
| 319 | 420 | COMB3 | Combination | 620.08 | -32.45 | -2429.47 | -12147.37 |
| 320 | 320 | DEAD | LinStatic | -0.28 | -28.12 | -30.66 | -153.3 |
| 320 | 420 | DEAD | LinStatic | -0.38 | -28.13 | -18.65 | -93.25 |
| 320 | 320 | COMB1 | Combination | -0.4 | -39.36 | -42.92 | -214.62 |
| 320 | 420 | COMB1 | Combination | -0.53 | -39.39 | -26.11 | -130.55 |
| 320 | 320 | COMB2 | Combination | 928.62 | -33.32 | -5858.54 | -29292.69 |
| 320 | 420 | COMB2 | Combination | 868.11 | -45.43 | -3401.26 | -17006.32 |
| 320 | 320 | COMB3 | Combination | 663.3 | -23.8 | -4184.67 | -20923.35 |
| 320 | 420 | COMB3 | Combination | 620.08 | -32.45 | -2429.47 | -12147.37 |
| 419 | 420 | DEAD | LinStatic | 0.89 | -21.78 | -18.66 | -93.3 |

**Tabel L1.1 Hasil *Output Element Forces-Area Shell* dari Sap 2000 dengan Beban Air 7 m (lanjutan)**

| Area | Joint | OutputCase | CaseType | F11 N/mm | F22 N/mm | M11 N-mm/mm | M22 N-mm/mm |
|---|---|---|---|---|---|---|---|
| 419 | 520 | DEAD | LinStatic | -0.1 | -21.97 | -7.65 | -38.27 |
| 419 | 420 | COMB1 | Combination | 1.25 | -30.49 | -26.12 | -130.62 |
| 419 | 520 | COMB1 | Combination | -0.15 | -30.76 | -10.72 | -53.58 |
| 419 | 420 | COMB2 | Combination | 875.58 | -8.07 | -3404.94 | -17024.72 |
| 419 | 520 | COMB2 | Combination | 650.07 | -53.18 | -1144.24 | -5721.21 |
| 419 | 420 | COMB3 | Combination | 625.41 | -5.77 | -2432.1 | -12160.51 |
| 419 | 520 | COMB3 | Combination | 464.33 | -37.98 | -817.32 | -4086.58 |
| 420 | 420 | DEAD | LinStatic | 0.89 | -21.78 | -18.66 | -93.3 |
| 420 | 520 | DEAD | LinStatic | -0.1 | -21.97 | -7.65 | -38.27 |
| 420 | 420 | COMB1 | Combination | 1.25 | -30.49 | -26.12 | -130.62 |
| 420 | 520 | COMB1 | Combination | -0.15 | -30.76 | -10.72 | -53.58 |
| 420 | 420 | COMB2 | Combination | 875.58 | -8.07 | -3404.94 | -17024.72 |
| 420 | 520 | COMB2 | Combination | 650.07 | -53.18 | -1144.24 | -5721.21 |
| 420 | 420 | COMB3 | Combination | 625.41 | -5.77 | -2432.1 | -12160.51 |
| 420 | 520 | COMB3 | Combination | 464.33 | -37.98 | -817.32 | -4086.58 |
| 519 | 520 | DEAD | LinStatic | 1.19 | -15.48 | -7.7 | -38.52 |
| 519 | 620 | DEAD | LinStatic | -0.21 | -15.77 | -1.43 | -7.16 |
| 519 | 520 | COMB1 | Combination | 1.67 | -21.68 | -10.78 | -53.92 |
| 519 | 620 | COMB1 | Combination | -0.3 | -22.07 | -2 | -10.02 |
| 519 | 520 | COMB2 | Combination | 662.1 | 6.97 | -1154.95 | -5774.75 |
| 519 | 620 | COMB2 | Combination | 373.68 | -50.72 | 144.73 | 723.65 |
| 519 | 520 | COMB3 | Combination | 472.93 | 4.98 | -824.96 | -4124.82 |
| 519 | 620 | COMB3 | Combination | 266.92 | -36.23 | 103.38 | 516.9 |
| 520 | 520 | DEAD | LinStatic | 1.19 | -15.48 | -7.7 | -38.52 |
| 520 | 620 | DEAD | LinStatic | -0.21 | -15.77 | -1.43 | -7.16 |
| 520 | 520 | COMB1 | Combination | 1.67 | -21.68 | -10.78 | -53.92 |
| 520 | 620 | COMB1 | Combination | -0.3 | -22.07 | -2 | -10.02 |
| 520 | 520 | COMB2 | Combination | 662.1 | 6.97 | -1154.95 | -5774.75 |
| 520 | 620 | COMB2 | Combination | 373.68 | -50.72 | 144.73 | 723.65 |
| 520 | 520 | COMB3 | Combination | 472.93 | 4.98 | -824.96 | -4124.82 |
| 520 | 620 | COMB3 | Combination | 266.92 | -36.23 | 103.38 | 516.9 |
| 619 | 620 | DEAD | LinStatic | 1.1 | -9.22 | -1.5 | -7.51 |
| 619 | 720 | DEAD | LinStatic | -0.41 | -9.53 | 0.53 | 2.63 |
| 619 | 620 | COMB1 | Combination | 1.54 | -12.91 | -2.1 | -10.51 |
| 619 | 720 | COMB1 | Combination | -0.58 | -13.34 | 0.74 | 3.68 |
| 619 | 620 | COMB2 | Combination | 387.01 | 15.9 | 130.62 | 653.1 |
| 619 | 720 | COMB2 | Combination | 96.76 | -42.15 | 375.58 | 1877.88 |
| 619 | 620 | COMB3 | Combination | 276.43 | 11.36 | 93.3 | 466.5 |
| 619 | 720 | COMB3 | Combination | 69.12 | -30.11 | 268.27 | 1341.34 |
| 620 | 620 | DEAD | LinStatic | 1.1 | -9.22 | -1.5 | -7.51 |

**Tabel L1.1 Hasil *Output Element Forces-Area Shell* dari Sap 2000 dengan Beban Air 7 m (lanjutan)**

| Area | Joint | OutputCase | CaseType | F11 N/mm | F22 N/mm | M11 N-mm/mm | M22 N-mm/mm |
|---|---|---|---|---|---|---|---|
| 620 | 720 | DEAD | LinStatic | -0.41 | -9.53 | 0.53 | 2.63 |
| 620 | 620 | COMB2 | Combination | 387.01 | 15.9 | 130.62 | 653.1 |
| 620 | 720 | COMB2 | Combination | 96.76 | -42.15 | 375.58 | 1877.88 |
| 620 | 620 | COMB3 | Combination | 276.43 | 11.36 | 93.3 | 466.5 |
| 620 | 720 | COMB3 | Combination | 69.12 | -30.11 | 268.27 | 1341.34 |
| 719 | 720 | DEAD | LinStatic | 0.9 | -2.97 | 0.45 | 2.24 |
| 719 | 820 | DEAD | LinStatic | -0.61 | -3.28 | 0.0404 | 0.2 |
| 719 | 720 | COMB1 | Combination | 1.26 | -4.16 | 0.63 | 3.13 |
| 719 | 820 | COMB1 | Combination | -0.85 | -4.59 | 0.05655 | 0.28 |
| 719 | 720 | COMB2 | Combination | 109.87 | 23.36 | 360.38 | 1801.92 |
| 719 | 820 | COMB2 | Combination | -167.49 | -32.11 | 7.67 | 38.37 |
| 719 | 720 | COMB3 | Combination | 78.48 | 16.69 | 257.42 | 1287.08 |
| 719 | 820 | COMB3 | Combination | -119.63 | -22.94 | 5.48 | 27.41 |
| 720 | 720 | DEAD | LinStatic | 0.9 | -2.97 | 0.45 | 2.24 |
| 720 | 820 | DEAD | LinStatic | -0.61 | -3.28 | 0.0404 | 0.2 |
| 720 | 720 | COMB1 | Combination | 1.26 | -4.16 | 0.63 | 3.13 |
| 720 | 820 | COMB1 | Combination | -0.85 | -4.59 | 0.05655 | 0.28 |
| 720 | 720 | COMB2 | Combination | 109.87 | 23.36 | 360.38 | 1801.92 |
| 720 | 820 | COMB2 | Combination | -167.49 | -32.11 | 7.67 | 38.37 |
| 720 | 720 | COMB3 | Combination | 78.48 | 16.69 | 257.42 | 1287.08 |
| 720 | 820 | COMB3 | Combination | -119.63 | -22.94 | 5.48 | 27.41 |

## L1.2 Hasil *Output* dari SAP 2000 dengan Beban Air 4 m

Hasil *ouput* nilai momen dan tegangan yang bekerja pada dinding tangki dengan beban air setinggi 4 m yang digunakan dalam perhitungan sebelumnya dapat dilihat pada Tabel L1.2.

**Tabel L1.2 Hasil *Output Element Forces-Area Shell* dari Sap 2000 dengan Beban Air 4 m**

| Area | Joint | OutputCase | CaseType | F11 N/mm | F22 N/mm | M11 N-mm/mm | M22 N-mm/mm |
|---|---|---|---|---|---|---|---|
| 19 | 39 | COMB2 | Combination | -15.57 | -77.86 | 8177.92 | 40889.6 |
| 19 | 40 | COMB2 | Combination | 106.81 | -53.39 | -1066.02 | -5330.12 |
| 20 | 39 | COMB2 | Combination | -15.57 | -77.86 | 8177.92 | 40889.6 |
| 20 | 40 | COMB2 | Combination | 106.81 | -53.39 | -1066.02 | -5330.12 |
| 119 | 40 | COMB2 | Combination | 103.54 | -69.72 | -1068.78 | -5343.91 |
| 119 | 220 | COMB2 | Combination | 232 | -44.03 | -3148.53 | -15742.7 |

**Tabel L1.2 Hasil *Output Element Forces-Area Shell* dari Sap 2000 dengan Beban Air 4 m (lanjutan)**

| Area | Joint | OutputCase | CaseType | F11 N/mm | F22 N/mm | M11 N-mm/mm | M22 N-mm/mm |
|---|---|---|---|---|---|---|---|
| 120 | 40 | COMB2 | Combination | 103.54 | -69.72 | -1068.78 | -5343.91 |
| 120 | 220 | COMB2 | Combination | 232 | -44.03 | -3148.53 | -15742.7 |
| 219 | 220 | COMB2 | Combination | 231.09 | -48.57 | -3145.64 | -15728.2 |
| 219 | 320 | COMB2 | Combination | 235.53 | -47.68 | -1838.53 | -9192.66 |
| 220 | 220 | COMB2 | Combination | 231.09 | -48.57 | -3145.64 | -15728.2 |
| 220 | 320 | COMB2 | Combination | 235.53 | -47.68 | -1838.53 | -9192.66 |
| 319 | 320 | COMB2 | Combination | 238.78 | -31.41 | -1837.92 | -9189.62 |
| 319 | 420 | COMB2 | Combination | 159.09 | -47.34 | -11.43 | -57.14 |
| 320 | 320 | COMB2 | Combination | 238.78 | -31.41 | -1837.92 | -9189.62 |
| 320 | 420 | COMB2 | Combination | 159.09 | -47.34 | -11.43 | -57.14 |
| 419 | 420 | COMB2 | Combination | 164.23 | -21.68 | -13.84 | -69.18 |
| 419 | 520 | COMB2 | Combination | 74.8 | -39.57 | 671.61 | 3358.03 |
| 420 | 420 | COMB2 | Combination | 164.23 | -21.68 | -13.84 | -69.18 |
| 420 | 520 | COMB2 | Combination | 74.8 | -39.57 | 671.61 | 3358.03 |
| 519 | 520 | COMB2 | Combination | 79.61 | -15.5 | 667.99 | 3339.96 |
| 519 | 620 | COMB2 | Combination | 15.82 | -28.25 | 537.41 | 2687.03 |
| 520 | 520 | COMB2 | Combination | 79.61 | -15.5 | 667.99 | 3339.96 |
| 520 | 620 | COMB2 | Combination | 15.82 | -28.25 | 537.41 | 2687.03 |
| 619 | 620 | COMB2 | Combination | 19.64 | -9.14 | 534.25 | 2671.25 |
| 619 | 720 | COMB2 | Combination | -20.17 | -17.11 | 184.69 | 923.44 |
| 620 | 620 | COMB2 | Combination | 19.64 | -9.14 | 534.25 | 2671.25 |
| 620 | 720 | COMB2 | Combination | -20.17 | -17.11 | 184.69 | 923.44 |
| 719 | 720 | COMB2 | Combination | -17.03 | -1.41 | 182.4 | 911.99 |
| 719 | 820 | COMB2 | Combination | -46.68 | -7.34 | 0.94 | 4.7 |
| 720 | 720 | COMB2 | Combination | -17.03 | -1.41 | 182.4 | 911.99 |
| 19 | 39 | COMB3 | Combination | -11.12 | -55.62 | 5841.37 | 29206.87 |
| 19 | 40 | COMB3 | Combination | 76.29 | -38.13 | -761.45 | -3807.23 |
| 20 | 39 | COMB3 | Combination | -11.12 | -55.62 | 5841.37 | 29206.87 |
| 20 | 40 | COMB3 | Combination | 76.29 | -38.13 | -761.45 | -3807.23 |
| 119 | 40 | COMB3 | Combination | 73.96 | -49.8 | -763.42 | -3817.08 |
| 119 | 220 | COMB3 | Combination | 165.71 | -31.45 | -2248.95 | -11244.77 |
| 120 | 40 | COMB3 | Combination | 73.96 | -49.8 | -763.42 | -3817.08 |
| 120 | 220 | COMB3 | Combination | 165.71 | -31.45 | -2248.95 | -11244.77 |
| 219 | 220 | COMB3 | Combination | 165.07 | -34.69 | -2246.89 | -11234.44 |
| 219 | 320 | COMB3 | Combination | 168.23 | -34.06 | -1313.24 | -6566.18 |
| 220 | 220 | COMB3 | Combination | 165.07 | -34.69 | -2246.89 | -11234.44 |
| 220 | 320 | COMB3 | Combination | 168.23 | -34.06 | -1313.24 | -6566.18 |
| 319 | 320 | COMB3 | Combination | 170.56 | -22.43 | -1312.8 | -6564.01 |
| 319 | 420 | COMB3 | Combination | 113.64 | -33.82 | -8.16 | -40.82 |

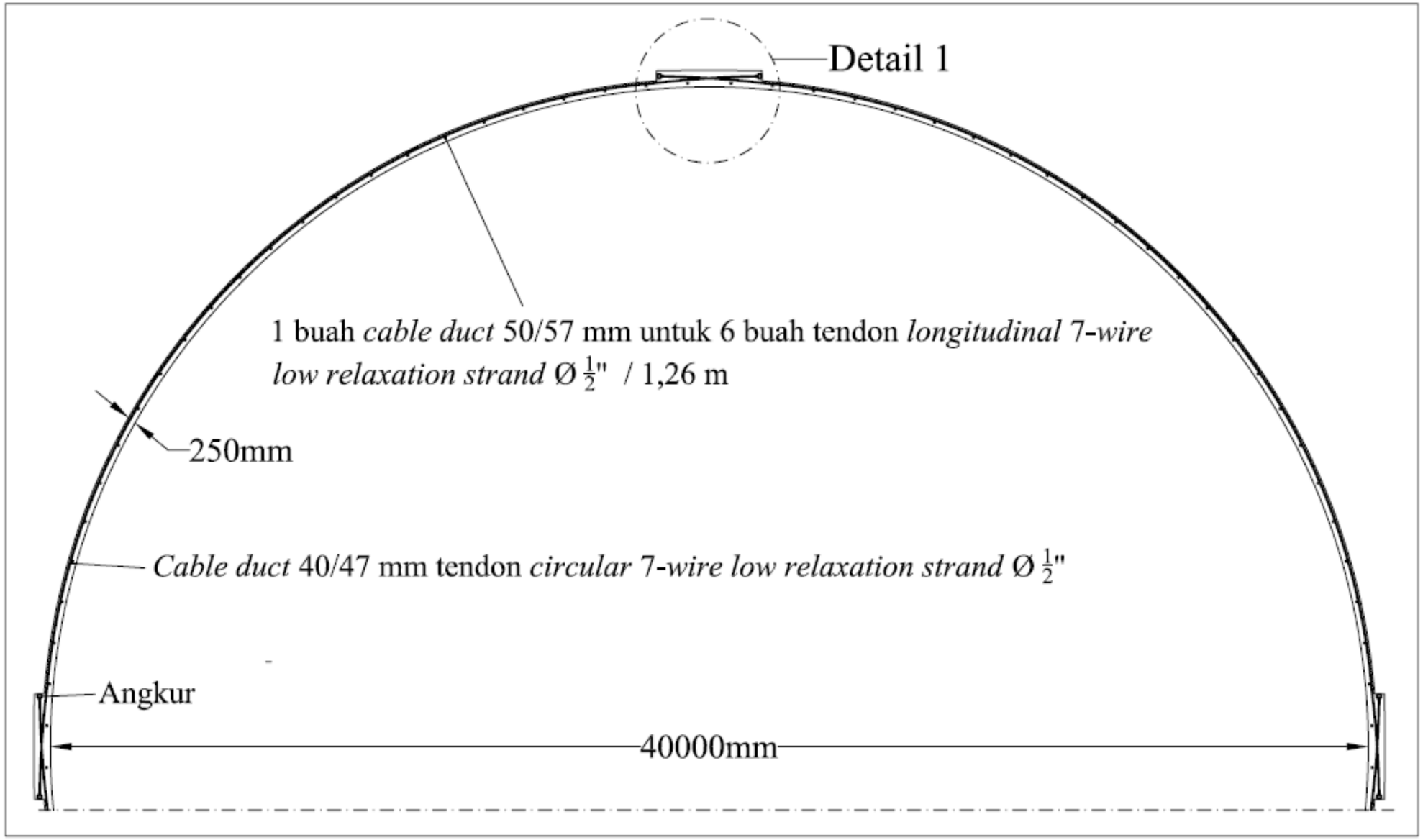
**Tabel L1.2 Hasil *Output Element Forces-Area Shell* dari Sap 2000 dengan Beban Air 4 m (lanjutan)**

| Area | Joint | OutputCase | CaseType | F11 N/mm | F22 N/mm | M11 N-mm/mm | M22 N-mm/mm |
|---|---|---|---|---|---|---|---|
| 320 | 320 | COMB3 | Combination | 170.56 | -22.43 | -1312.8 | -6564.01 |
| 320 | 420 | COMB3 | Combination | 113.64 | -33.82 | -8.16 | -40.82 |
| 419 | 420 | COMB3 | Combination | 117.3 | -15.49 | -9.88 | -49.42 |
| 419 | 520 | COMB3 | Combination | 53.43 | -28.26 | 479.72 | 2398.59 |
| 420 | 420 | COMB3 | Combination | 117.3 | -15.49 | -9.88 | -49.42 |
| 420 | 520 | COMB3 | Combination | 53.43 | -28.26 | 479.72 | 2398.59 |
| 519 | 520 | COMB3 | Combination | 56.87 | -11.07 | 477.14 | 2385.68 |
| 519 | 620 | COMB3 | Combination | 11.3 | -20.18 | 383.86 | 1919.31 |
| 520 | 520 | COMB3 | Combination | 56.87 | -11.07 | 477.14 | 2385.68 |
| 520 | 620 | COMB3 | Combination | 11.3 | -20.18 | 383.86 | 1919.31 |
| 619 | 620 | COMB3 | Combination | 14.03 | -6.53 | 381.61 | 1908.03 |
| 619 | 720 | COMB3 | Combination | -14.41 | -12.22 | 131.92 | 659.6 |
| 620 | 620 | COMB3 | Combination | 14.03 | -6.53 | 381.61 | 1908.03 |
| 620 | 720 | COMB3 | Combination | -14.41 | -12.22 | 131.92 | 659.6 |
| 719 | 720 | COMB3 | Combination | -12.17 | -1.01 | 130.28 | 651.42 |
| 719 | 820 | COMB3 | Combination | -33.35 | -5.24 | 0.67 | 3.36 |
| 720 | 720 | COMB3 | Combination | -12.17 | -1.01 | 130.28 | 651.42 |
| 720 | 820 | COMB3 | Combination | -33.35 | -5.24 | 0.67 | 3.36 |

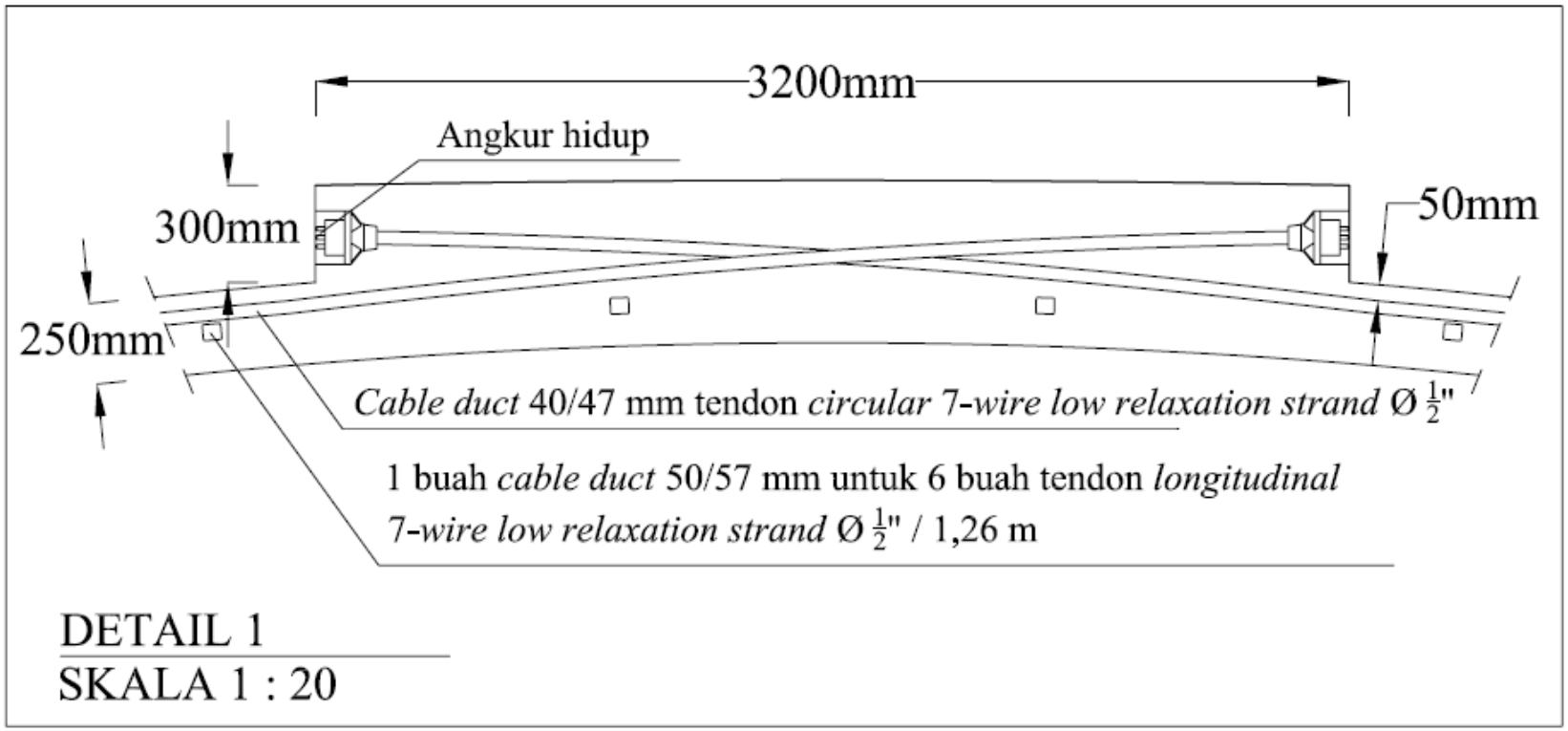
# LAMPIRAN 2

# GAMBAR STRUKTUR TANGKI AIR

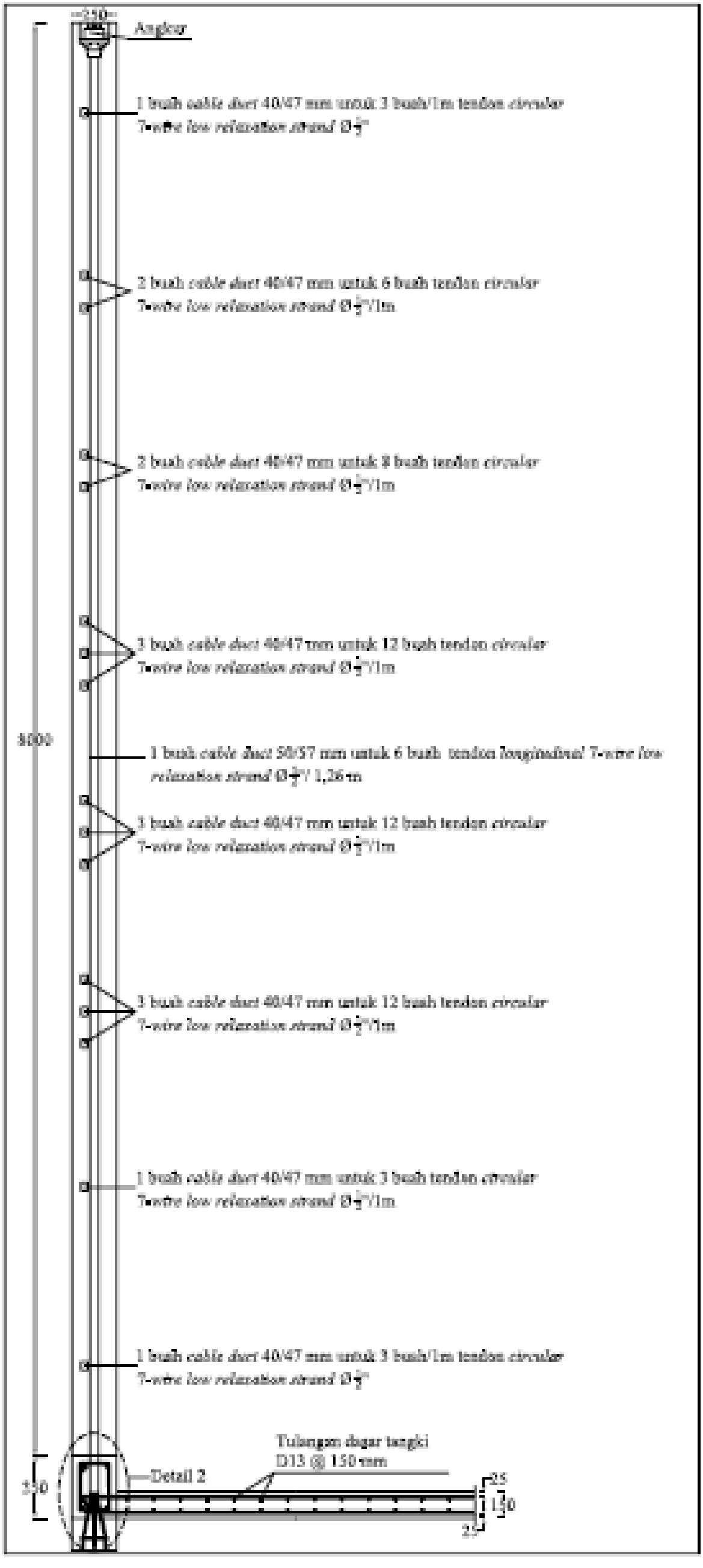
## L2.1 Gambar Struktur Tangki Air



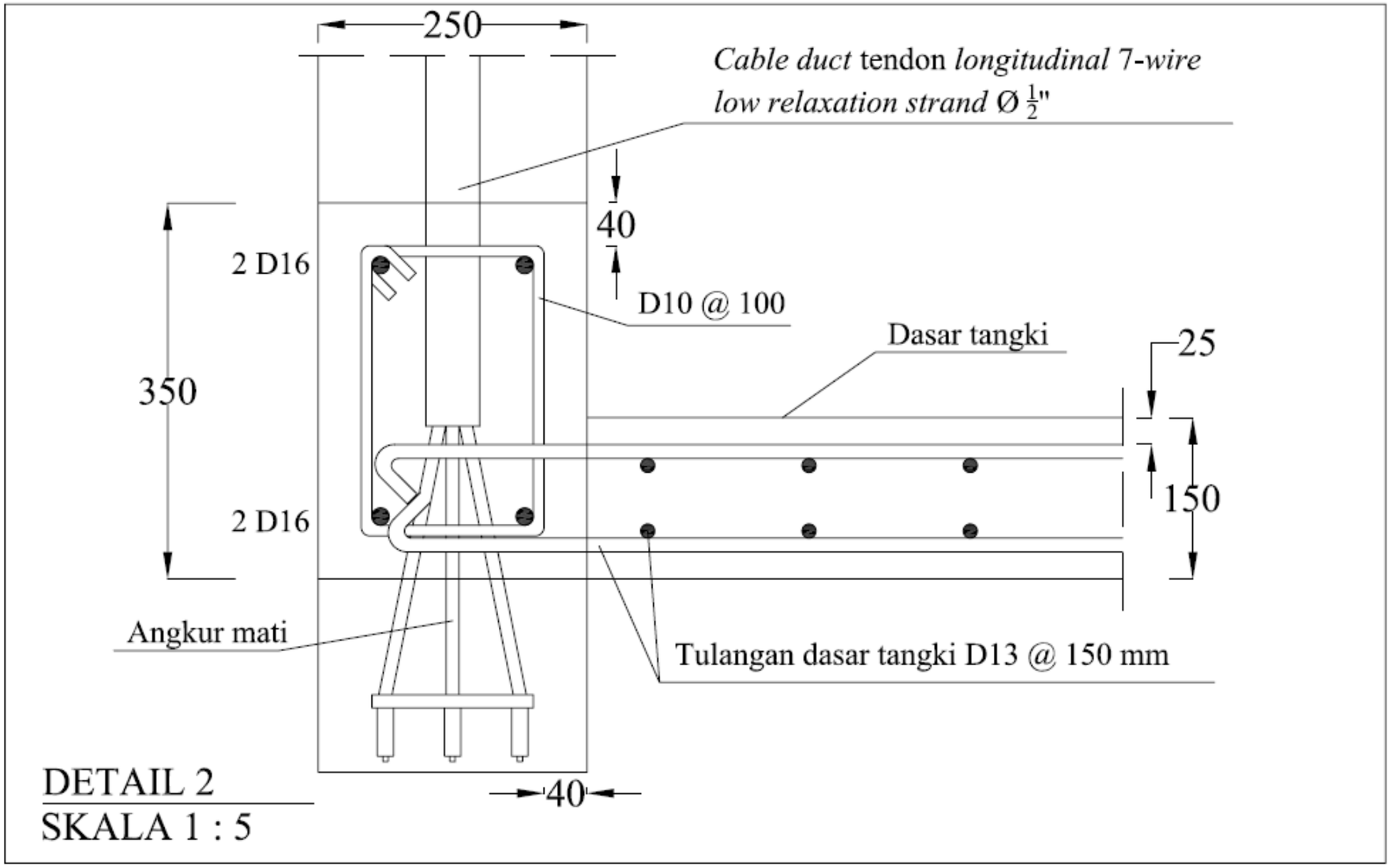

**Gambar L2.1 Potongan Melintang Tangki Air**




**Gambar L2.2 Detail 1**




**Gambar L2.3 Potongan Vertikal Tangki Air**




**Gambar L2.4 Detail 2**

# LAMPIRAN 3

# MANUAL DARI VSL

## L3.1 Manual dari VSL

Data *strand properties* yang digunakan dapat dilihat pada Tabel L3.1 dan data *tendon properties* yang digunakan dapat dilihat pada Tabel L3.2.

**Tabel L3.1 *Strand Properties***

| Strand type | | 13 mm (0.5") | | 15 mm (0.6") | |
|---|---|---|---|---|---|
| | | Euronorm 138-79 or BS 5896: 1980 Super | ASTM A 416-65 Grade 270 | Euronorm 138-79 or BS 5896: 1980 Super | ASTM A 416-65 Grade 270 |
| Nominal diameter | (mm) | 12.9 | 12.7 | 15.7 | 15.2 |
| Nominal area | ($mm^2$) | 100 | 98.7 | 150 | 140 |
| Nominal mass | (kg/m) | 0.785 | 0.775 | 1.18 | 1.10 |
| Yield strength | (MPa) | 1580[1] | 1670[2] | 1500[1] | 1670[2] |
| Tensile strength | (MPa) | 1860 | 1860 | 1770 | 1860 |
| Min. breaking load $P_N$ | (kN) | 186.0 | 183.7 | 265.0 | 260.7 |
| Young's modulus | (GPa) | circa 195 | | | |
| Relaxation[3] after 1000 h at 20°C and 0.7 × $P_N$ | (%) | max. 2.5 | | | |

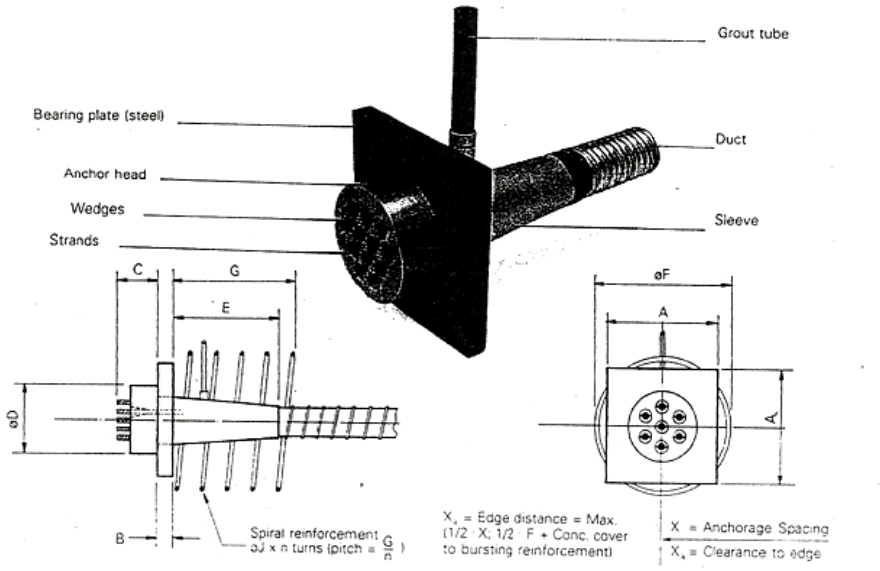
1) Measured at 0.1% residual strain (0.1% offset method)
2) Measured at 1.0% extension (1% extension under load method)
3) Valid for relaxation class 2 acc. to Euronorm 138-79/BS 5896:1980, or low relaxation grade acc. to ASTM A 416-85

**Tabel L3.2 *Tendon Properties***

| 13 mm (0.5") strand | | | | |
|---|---|---|---|---|
| Tendon unit | Number of strands | Duct diameter[1] internal/ external (mm) | Min. breaking load | |
| | | | Strand type Euronorm 138-79 or BS 5896: 1980, Super (kN) | Strand type ASTM A416-85 Grade 270 (kN) |
| 5-1 | 1 | 26/32 | 186 | 184 |
| 5-2 | 2 | 35/42 | 372 | 367 |
| 5-3 | 3 | 35/42 | 558 | 551 |
| 5-4 | 4 | 40/47 | 744 | 735 |
| 5-6[2] | 6 | 50/57 | 1116 | 1102 |
| 5-7 | 7 | 50/57 | 1302 | 1286 |
| 5-12 | 12 | 65/72 | 2232 | 2204 |
| 5-18[2] | 18 | 80/87 | 3348 | 3307 |
| 5-19 | 19 | 80/87 | 3534 | 3490 |
| 5-22 | 22 | 85/92 | 4092 | 4041 |
| 5-27 | 27 | 100/107 | 5022 | 4968 |
| 5-31 | 31 | 100/107 | 5766 | 5695 |
| 5-37 | 37 | 110/117 | 6882 | 6797 |
| 5-42 | 42 | 120/127 | 7812 | 7728 |
| 5-55 | 55 | 140/147 | 10230 | 10104 |

| 15 mm (0.6") strand | | | | |
|---|---|---|---|---|
| Tendon unit | Number of strands | Duct diameter[1] internal/ external (mm) | Min. breaking load | |
| | | | Strand type Euronorm 138-79 or BS 5896: 1980, Super (kN) | Strand type ASTM A416-85 Grade 270 (kN) |
| 6-1 | 1 | 30/35 | 265 | 261 |
| 6-2 | 2 | 35/42 | 530 | 521 |
| 6-3 | 3 | 45/52 | 795 | 782 |
| 6-4 | 4 | 50/57 | 1060 | 1043 |
| 6-6[2] | 6 | 60/67 | 1590 | 1564 |
| 6-7 | 7 | 60/67 | 1855 | 1825 |
| 6-12 | 12 | 80/87 | 3180 | 3128 |
| 6-18[2] | 18 | 95/102 | 4770 | 4693 |
| 6-19 | 19 | 95/102 | 5035 | 4953 |
| 6-22 | 22 | 110/117 | 5830 | 5735 |
| 6-31 | 31 | 120/127 | 8215 | 8082 |
| 6-37 | 37 | 140/147 | 9805 | 9646 |

1) Standard size for corrugated steel ducts.
For polyethylene ducts PT-PLUS® see page 6.
2) For intermediate stressing anchorages type Z.



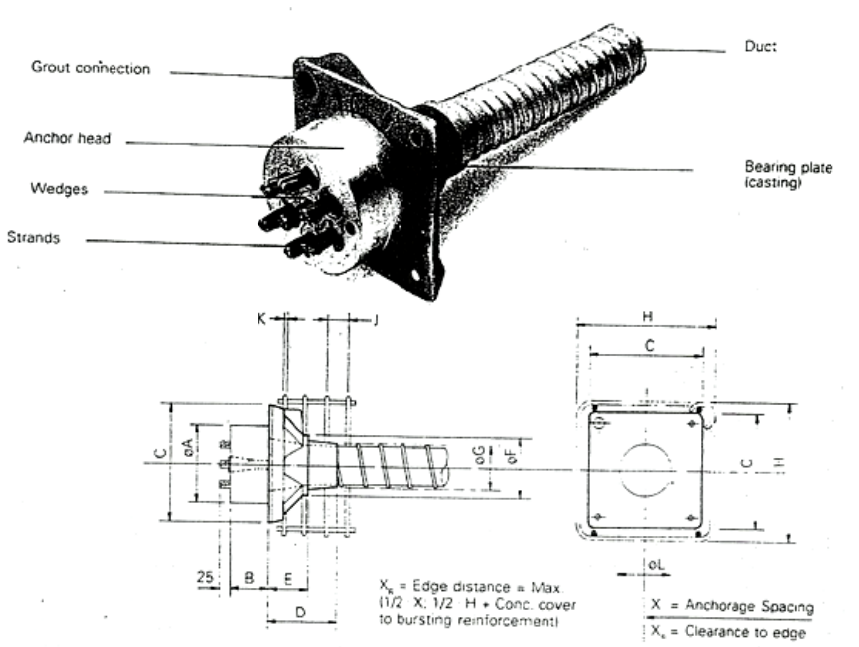

| | Tendon unit | A | B | C | øD | E | øF | G | H recommended | øJ | n | X[a] |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Strand type 13 mm (0.5") | 5-1 | 70 | 15 | 75 | 42 | 70 | 80 | 90 | 25/30 | 8 | 2 | 90 |
| | 5-3 | 115 | 20 | 80 | 90 | 190 | 130 | 150 | 40/45 | 10 | 3 | 155 |
| | 5-4 | 130 | 20 | 80 | 95 | 190 | 160 | 150 | 45/50 | 10 | 3 | 180 |
| | 5-7 | 175 | 25 | 85 | 110 | 190 | 205 | 200 | 55/60 | 12 | 4 | 235 |
| | 5-12 | 230 | 35 | 90 | 150 | 370 | 285 | 250 | 65/72 | 14 | 5 | 305 |
| | 5-19 | 290 | 40 | 105 | 180 | 470 | 365 | 300 | 80/87 | 16 | 6 | 385 |
| | 5-22 | 315 | 45 | 115 | 190 | 480 | 395 | 360 | 85/92 | 18 | 6 | 415 |
| | 5-31 | 370 | 55 | 125 | 230 | 550 | 470 | 400 | 100/107 | 18 | 8 | 490 |
| | 5-37 | 405 | 60 | 135 | 240 | 570 | 510 | 420 | 120/127 | 20 | 7 | 535 |
| | 5-43 | 440 | 60 | 145 | 260 | 680 | 550 | 480 | 130/137 | 20 | 8 | 580 |
| | 5-55 | 500 | 70 | 160 | 290 | 680 | 620 | 540 | 140/150 | 22 | 9 | 655 |
| Strand type 15 mm (0.6") | 6-1 | 75 | 15 | 80 | 53 | 70 | 80 | 90 | 30/35 | 8 | 2 | 105 |
| | 6-2 | 110 | 15 | 80 | 90 | 190 | 130 | 150 | 45/50 | 10 | 3 | 150 |
| | 6-3 | 135 | 20 | 80 | 95 | 190 | 160 | 150 | 45/50 | 10 | 3 | 185 |
| | 6-4 | 160 | 25 | 85 | 110 | 190 | 190 | 200 | 50/55 | 12 | 4 | 210 |
| | 6-7 | 205 | 35 | 90 | 135 | 290 | 260 | 250 | 60/67 | 14 | 5 | 280 |
| | 6-12 | 270 | 40 | 105 | 170 | 460 | 345 | 300 | 80/87 | 16 | 6 | 365 |
| | 6-19 | 340 | 50 | 125 | 200 | 590 | 440 | 350 | 95/102 | 18 | 7 | 460 |
| | 6-22 | 370 | 55 | 130 | 220 | 690 | 470 | 400 | 110/117 | 18 | 8 | 495 |
| | 6-31 | 435 | 65 | 150 | 260 | 690 | 560 | 480 | 130/137 | 20 | 8 | 590 |
| | 6-37 | 480 | 70 | 165 | 270 | 830 | 610 | 540 | 140/150 | 22 | 9 | 640 |
| | 6-43 | 520 | 75 | 175 | 300 | 950 | 650 | 640 | 150/160 | 26 | 8 | 690 |
| | 6-55 | 580 | 90 | 190 | 320 | 950 | 740 | 630 | 170/180 | 26 | 9 | 780 |

Dimensions in mm

Subject to modification

- Recommended duct diameter are for corrugated steel ducts. Locally available diameters may vary slightly. For polyethylene ducts PT-PLUS® refer to page 6.
- Anchorage dimensions and bursting reinforcement are based on:
  nominal concrete cube strength at transfer: 24 MPa
  nominal concrete cube strength at 28 days: 30 MPa
  breaking load for ø 13mm (0.5") strands 186 kN
  breaking load for ø 15mm (0.6") loads 265 kN
  yield strength of bursting reinforcement ≥ 400 MPa
  maximum prestressing force at transfer: 80% of tendon breaking load
  maximum prestressing force after wedge draw-in: 75% of tendon breaking load
  Dimensions for other concrete-strengths on request.

**Gambar L3.1 Spesifikasi *Stressing Anchorage VSL Type E***




| Tendon unit | Strand type 13 mm (0.5") Duct ø (mm) Min | Norm | X | Spacing No of links | Bursting reinforcement ø K | J | H | Anchor heads B | ø A | Casting ø G | ø F | E | D | C |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 5-3 | 35/42 | 40/47 | 160 | 3 | 10 | 50 | 140 | 60 | 85 | | 58 | 54 | 102 | 135 |
| 5-4 | 40/47 | 40/47 | 180 | 3 | 10 | 50 | 160 | 60 | 85 | 50 | 58 | 57 | 102 | 135 |
| 5-7 | 50/57 | 50/57 | 230 | 4 | 12 | 50 | 200 | 60 | 110 | 70 | 85 | 60 | 100 | 165 |
| 5-12 | 60/67 | 65/72 | 300 | 5 | 16 | 55 | 270 | 56 | 150 | 92 | 120 | 85 | 160 | 215 |
| 5-19 | 75/82 | 80/87 | 380 | 6 | 16 | 55 | 350 | 70 | 180 | 107 | 145 | 110 | 210 | 265 |
| 5-22 | 80/87 | 85/92 | 420 | 6 | 20 | 65 | 390 | 77 | 200 | 112 | 150 | 140 | 215 | 290 |
| 5-27 | 95/102 | 100/107 | 490 | 7 | 20 | 65 | 460 | 92 | 220 | 145 | 175 | 160 | 250 | 315 |
| 5-31 | 95/102 | 100/107 | 490 | 7 | 20 | 65 | 460 | 100 | 230 | 145 | 175 | 160 | 250 | 315 |
| 5-37 | 110/117 | 110/117 | 530 | 7 | 20 | 70 | 500 | 107 | 250 | 134 | 200 | 160 | 320 | 370 |
| 5-42 | 120/127 | 120/127 | 565 | 8 | 22 | 70 | 530 | 112 | 290 | 144 | 217 | 160 | 340 | 390 |
| 5-55 | 130/137 | 140/147 | 660 | 9 | 22 | 70 | 620 | 150 | 320 | 165 | 250 | 160 | 340 | 465 |

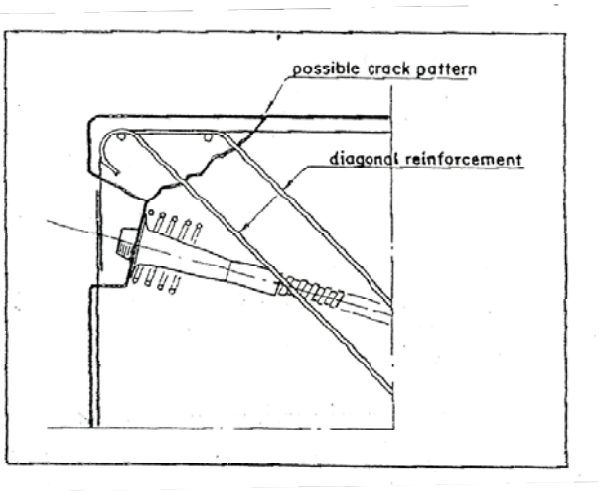
| Tendon unit | Strand type 15 mm (0.6") Duct ø (mm) Min | Norm | X | Spacing No of links | Bursting reinforcement ø K | J | H | Anchor heads B | ø A |
|---|---|---|---|---|---|---|---|---|---|
| 6-3 | 40/47 | 45/52 | 180 | 3 | 10 | 50 | 160 | 90 | 90 |
| 6-4 | 45/52 | 45/52 | 230 | 4 | 12 | 50 | 200 | 60 | 110 |
| 6-7 | 55/62 | 60/67 | 300 | 5 | 16 | 50 | 270 | 56 | 150 |
| 6-12 | 75/82 | 80/87 | 380 | 6 | 16 | 55 | 350 | 75 | 180 |
| 6-19 | 90/97 | 95/102 | 490 | 7 | 20 | 60 | 460 | 92 | 220 |
| 6-22 | 100/107 | 100/107 | 490 | 7 | 20 | 60 | 460 | 100 | 230 |
| 6-31 | 120/127 | 120/127 | 600 | 8 | 22 | 65 | 560 | 122 | 270 |
| 6-37 | 130/137 | 140/147 | 660 | 9 | 22 | 65 | 620 | 142 | 300 |

Dimensions in mm

Subject to modification

- Min and normal ducts diameters are for corrugated steel ducts. Locally available diameters may vary slightly. For polyethylene ducts PT-PLUS® refer to page 6.
- Anchorage dimensions/spacings and bursting reinforcement are based on:
  nominal concrete cube strength at transfer: 24 MPa
  nominal concrete cube strength at 28 days: 30 MPa
  breaking load for ø 13mm (0.5") strands 186 kN
  breaking load for ø 15mm (0.6") loads 265 kN
  yield strength of bursting reinforcement ≥ 400 MPa
  maximum prestressing force at transfer: 80% of tendon breaking load
  maximum prestressing force after wedge draw-in: 75% of tendon breaking load
  Dimensions for other concrete strength on request.

**Gambar L3.2 Spesifikasi *Stressing Anchorage VSL Type EC***




**Gambar L3.3 Detail Angkur**

# LAMPIRAN 4
# LENDUTAN IJIN MAKSIMUM

## L4.1 Lendutan Ijin Maksimum

Batasan untuk lendutan ijin maksimum yang digunakan diambil dasi SNI 03 – 2847 – 2002. Batasan-batasan tersebut selengkapnya dapat dilihat pada Tabel L4.1 di bawah ini.

**Tabel L4.1 Lendutan Ijin Maksimum [SNI 03 – 2847 – 2002]**

| Jenis komponen struktur | Lendutan yang diperhitungkan | Batas lendutan |
|---|---|---|
| Atap datar yang tidak menahan atau tidak disatukan dengan komponen nonstruktural yang mungkin akan rusak oleh lendutan yang besar | Lendutan seketika akibat beban hidup ($L$) | $\frac{\ell^a}{180}$ |
| Lantai yang tidak menahan atau tidak disatukan dengan komponen nonstruktural yang mungkin akan rusak oleh lendutan yang besar | Lendutan seketika akibat beban hidup ($L$) | $\frac{\ell}{360}$ |
| Konstruksi atap atau lantai yang menahan atau disatukan dengan komponen nonstruktural yang mungkin akan rusak oleh lendutan yang besar | Bagian dari lendutan total yang terjadi setelah pemasangan komponen nonstruktural (jumlah dari lendutan jangka panjang, akibat semua beban tetap yang bekerja, dan lendutan seketika, akibat penambahan beban hidup)[c] | $\frac{\ell^b}{480}$ |
| Konstruksi atap atau lantai yang menahan atau disatukan dengan komponen nonstruktural yang mungkin tidak akan rusak oleh lendutan yang besar. | | $\frac{\ell^d}{240}$ |

a Batasan ini tidak dima Batasan ini tidak dimaksudkan untuk mencegah kemungkinan penggenangan air. Kemungkinan penggenangan air harus diperiksa dengan melakukan perhitungan lendutan termasuk lendutan tambahan akibat adanya penggenangan air tersebut, dan mempertimbangkan pengaruh jangka panjang dari beban yang selalu bekerja, lawan lendut, toleransi konstruksi dan keandalan sistem drainase.
b Batas lendutan boleh dilampaui bila langkah pencegahan kerusakan terhadap komponen yang ditumpu atau yang disatukan telah dilakukan.
c Lendutan jangka panjang harus dihitung berdasarkan ketentuan 11.5.2.5 atau 11.5.4.2, tetapi boleh dikurangi dengan nilai lendutan yang terjadi sebelum penambahan komponen non-struktural. Besarnya nilai lendutan ini harus ditentukan berdasarkan data teknis yang dapat diterima berkenaan dengan karakteristik hubungan waktu dan lendutan dari komponen struktur yang serupa dengan komponen struktur yang ditinjau.
d Tetapi tidak boleh lebih besar dari toleransi yang disediakan untuk komponen non-struktur. Batasan ini boleh dilampaui bila ada lawan lendut yang disediakan sedemikian hingga lendutan total dikurangi lawan lendut tidak melebihi batas lendutan yang ada.