LAMPIRAN A

**Table A-1 Basic Allowable Stresses in Tension for Metals[1] (Cont'd)**

Numbers in Parentheses Refer to Notes for Appendix A Tables; Specifications Are ASTM Unless Otherwise Indicated

| Material | Spec. No. | P-No. or S-No. (5) | Grade | Notes | Min. Temp., °F (6) | Specified Min. Strength, ksi | | Min. Temp. to 100 | 200 | 300 | 400 | 500 | 600 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | Tensile | Yield | | | | | | |
| **Stainless Steel (3)(4) Pipes and Tubes (2)** | | | | | | | | | | | | | |
| 18Cr–10Ni–Ti pipe smls > 3/8 in. thick | A 312 | 8 | TP321 | (30)(36) | –425 | 70 | 25 | 16.7 | *16.7* | *16.7* | **16.7** | **16.1** | **15.2** |
| 18Cr–10Ni–Ti pipe > 3/8 in. thick | A 376 | | | | | | | | | | | | |
| 18Cr–8Ni tube | A 269 | 8 | TP304L | (14)(36) | –425 | 70 | 25 | 16.7 | *16.7* | *16.7* | **15.8** | **14.8** | **14.0** |
| 18Cr–8Ni pipe | A 312 | 8 | TP304L | . . . | –425 | | | | | | | | |
| Type 304L A 240 | A 358 | 8 | 304L | (36) | –425 | | | | | | | | |
| 16Cr–12Ni–2Mo tube | A 269 | 8 | TP316L | (14)(36) | –425 | 70 | 25 | 16.7 | *16.7* | *16.7* | **15.5** | **14.4** | **13.5** |
| 16Cr–12Ni–2Mo pipe | A 312 | 8 | TP316L | . . . | –425 | | | | | | | | |
| Type 316L A 240 | A 358 | 8 | 316L | (36) | –425 | | | | | | | | |
| 18Cr–10Ni–Ti pipe smls > 3/8 in. thick | A 312 | 8 | TP321 | (28)(30)(36) | –425 | 70 | 25 | 16.7 | *16.7* | *16.7* | **16.7** | **16.1** | **15.2** |
| 18Cr–10Ni–Ti pipe > 3/8 in. thick | A 376 | | | | | | | | | | | | |
| 18Cr–10Ni–Ti pipe smls > 3/4 in. thick | A 312 | 8 | TP321H | (30)(36) | –325 | | | | | | | | |

LAMPIRAN B

**Table A-1B Basic Quality Factors for Longitudinal Weld Joints in Pipes, Tubes, and Fittings $E_j$**

These quality factors are determined in accordance with para. 302.3.4(a). See also para. 302.3.4(b) and Table 302.3.4 for increased quality factors applicable in special cases. Specifications, except API, are ASTM.

| Spec. No. | Class (or Type) | Description | $E_j$ (2) | Appendix A Notes |
|---|---|---|---|---|
| **Carbon Steel** | | | | |
| API 5L | ... | Seamless pipe | 1.00 | ... |
| | ... | Electric resistance welded pipe | 0.85 | ... |
| | ... | Electric fusion welded pipe, double butt, straight or spiral seam | 0.95 | ... |
| | ... | Furnace butt welded | 0.60 | ... |
| A 53 | Type S | Seamless pipe | 1.00 | ... |
| | Type E | Electric resistance welded pipe | 0.85 | ... |
| | Type F | Furnace butt welded pipe | 0.60 | ... |
| A 105 | ... | Forgings and fittings | 1.00 | (9) |
| A 106 | ... | Seamless pipe | 1.00 | ... |
| A 134 | ... | Electric fusion welded pipe, single butt, straight or spiral seam | 0.80 | ... |
| A 135 | ... | Electric resistance welded pipe | 0.85 | ... |
| A 139 | ... | Electric fusion welded pipe, straight or spiral seam | 0.80 | ... |
| A 179 | ... | Seamless tube | 1.00 | ... |
| A 181 | ... | Forgings and fittings | 1.00 | (9) |
| A 234 | ... | Seamless and welded fittings | 1.00 | (16) |
| A 333 | ... | Seamless pipe | 1.00 | ... |
| | ... | Electric resistance welded pipe | 0.85 | ... |
| A 334 | ... | Seamless tube | 1.00 | ... |
| A 350 | ... | Forgings and fittings | 1.00 | (9) |
| A 369 | ... | Seamless pipe | 1.00 | ... |
| A 381 | ... | Electric fusion welded pipe, 100% radiographed | 1.00 | (18) |
| | ... | Electric fusion welded pipe, spot radiographed | 0.90 | (19) |
| | ... | Electric fusion welded pipe, as manufactured | 0.85 | ... |
| A 420 | ... | Welded fittings, 100% radiographed | 1.00 | (16) |
| A 524 | ... | Seamless pipe | 1.00 | ... |
| A 587 | ... | Electric resistance welded pipe | 0.85 | ... |
| A 671 | 12, 22, 32, 42, 52 | Electric fusion welded pipe, 100% radiographed | 1.00 | ... |
| | 13, 23, 33, 43, 53 | Electric fusion welded pipe, double butt seam | 0.85 | ... |
| A 672 | 12, 22, 32, 42, 52 | Electric fusion welded pipe, 100% radiographed | 1.00 | ... |
| | 13, 23, 33, 43, 53 | Electric fusion welded pipe, double butt seam | 0.85 | ... |
| A 691 | 12, 22, 32, 42, 52 | Electric fusion welded pipe, 100% radiographed | 1.00 | ... |
| | 13, 23, 33, 43, 53 | Electric fusion welded pipe, double butt seam | 0.85 | ... |
| **Low and Intermediate Alloy Steel** | | | | |
| A 182 | ... | Forgings and fittings | 1.00 | (9) |
| A 234 | ... | Seamless and welded fittings | 1.00 | (16) |

LAMPIRAN C

(04)

## Table A-2 Design Stress Values for Bolting Materials[1]

Numbers in Parentheses Refer to Notes for Appendix A Tables; Specifications Are ASTM

| Material | Spec. No. | Grade | Size Range, Diam., in. | Notes | Min. Temp., °F (6) | Specified Min. Strength, ksi | | Min. Temp. | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | Tensile | Yield | to 100 | 200 | 300 | 400 | 500 | 600 |
| **Carbon Steel** | | | | | | | | | | | | | |
| ... | A 675 | 45 | ... | (8f)(8g) | −20 | 45 | 22.5 | 11.2 | 11.2 | 11.2 | 11.2 | 11.2 | 11.2 |
| ... | A 675 | 50 | ... | (8f)(8g) | −20 | 50 | 25 | 12.5 | 12.5 | 12.5 | 12.5 | 12.5 | 12.5 |
| ... | A 675 | 55 | ... | (8f)(8g) | −20 | 55 | 27.5 | 13.7 | 13.7 | 13.7 | 13.7 | 13.7 | 13.7 |
| ... | A 307 | B | ... | (8f)(8g) | −20 | 60 | ... | 13.7 | 13.7 | 13.7 | 13.7 | 13.7 | ... |
| ... | A 675 | 60 | ... | (8f)(8g) | −20 | 60 | 30 | 15.0 | 15.0 | 15.0 | 15.0 | 15.0 | 15.0 |
| ... | A 675 | 65 | ... | (8g) | −20 | 65 | 32.5 | 16.2 | 16.2 | 16.2 | 16.2 | 16.2 | 16.2 |
| ... | A 675 | 70 | ... | (8g) | −20 | 70 | 35 | 17.5 | 17.5 | 17.5 | 17.5 | 17.5 | 17.5 |
| ... | A 325 | ... | ... | (8g) | −20 | 105 | 81 | 19.3 | 19.3 | 19.3 | 19.3 | 19.3 | 19.3 |
| ... | A 675 | 80 | ... | (8g) | −20 | 80 | 40 | 20.0 | 20.0 | 20.0 | 20.0 | 20.0 | 20.0 |
| Nuts | A 194 | 1 | ... | (42) | −20 | ... | ... | ... | ... | ... | ... | ... | ... |
| Nuts | A 194 | 2, 2H | ... | (42) | −55 | ... | ... | ... | ... | ... | ... | ... | ... |
| ... | A 194 | 2HM | | | | | | | | | | | |
| Nuts | A 563 | A, hvy hex | ... | (42b) | −20 | ... | ... | ... | ... | ... | ... | ... | ... |
| **Alloy Steel** | | | | | | | | | | | | | |
| Cr–0.2Mo | A 193 | B7M | ≤ 4 | ... | −55 | 100 | 80 | 20.0 | 20.0 | 20.0 | 20.0 | 20.0 | 20.0 |
| Cr–0.20Mo | A 320 | L7M | ≤ 2½ | ... | −100 | | | | | | | | |
| 5Cr | A 193 | B5 | ≤ 4 | (15) | −20 | 100 | 80 | 20.0 | 20.0 | 20.0 | 20.0 | 20.0 | 20.0 |
| Cr–Mo–V | A 193 | B16 | > 2½, ≤ 4 | (15) | −20 | 110 | 95 | 22.0 | 22.0 | 22.0 | 22.0 | 22.0 | 22.0 |
| ... | A 354 | BC | ... | (15) | 0 | 115 | 99 | 23.0 | 23.0 | 23.0 | 23.0 | 23.0 | 23.0 |
| Cr–Mo | A 193 | B7 | > 2½, ≤ 4 | (15) | −40 | 115 | 95 | 23.0 | 23.0 | 23.0 | 23.0 | 23.0 | 23.0 |
| Ni–Cr–Mo | A 320 | L43 | ≤ 4 | (15) | −150 | 125 | 105 | 25.0 | 25.0 | 25.0 | 25.0 | 25.0 | 25.0 |
| Cr–Mo | A 320 | L7 | ≤ 2½ | | | | | | | | | | |
| Cr–Mo | A 320 | L7A, L7B, L7C | ≤ 2½ | (15) | −150 | 125 | 105 | 25.0 | 25.0 | 25.0 | 25.0 | 25.0 | 25.0 |

LAMPIRAN D

Contoh kasus sederhana

1. Sebuah pipa dengan diameter 8 inchi dengan *schedule* 140 terbuat dari material A312-TP304L sepanjang 4 meter dikenai beban tekanan internal sebesar 12 MPa, berapakah nilai tegangan sirkumferensial (*hoop stress*) ?

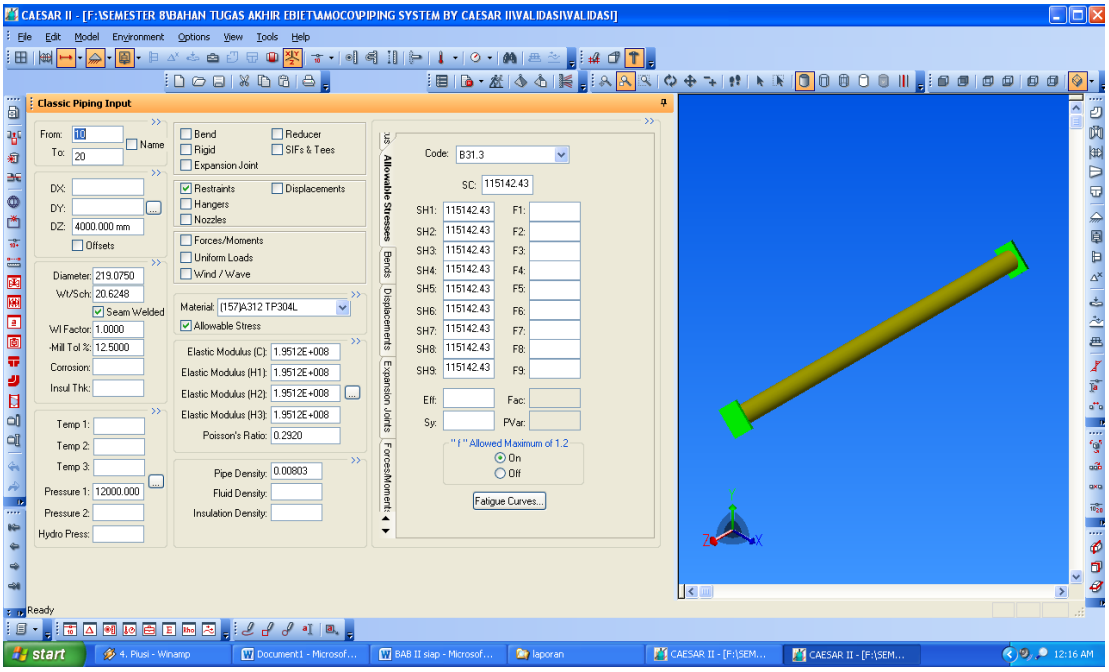
   - Perhitungan manual

$$S_H = \frac{P \,.\, do}{2 \,.\, t}$$

$$S_H = \frac{12\,\text{MPa} \,.\, 219mm}{2 \,.\, 21\text{mm}}$$

$$S_H = 62{,}57\,\text{MPa}$$

   - Menggunakan *software* CAESAR



CAESAR II Ver.5.00.6, (Build 061102) Date: SEP 24, 2012 Time: 0:16
Job: F:\SEMESTER 8\BAHAN TUGAS AKHIR EBIET\AMOCO\PIPI...\VALIDASI
Licensed To: -- ID #1234
STRESSES EXTENDED REPORT: Stresses on Elements
CASE 1 (SUS) W+P1

| NODE | Axial Stress KPa | Bending Stress KPa | Torsion Stress KPa | Hoop Stress KPa | Max Stress Intensity KPa | SIF In Plane | SIF Out Plane | Code Stress KPa | Allowable Stress KPa | Ratio % |
|---|---|---|---|---|---|---|---|---|---|---|

Piping Code: B31.3 -2004, April 29, 2005

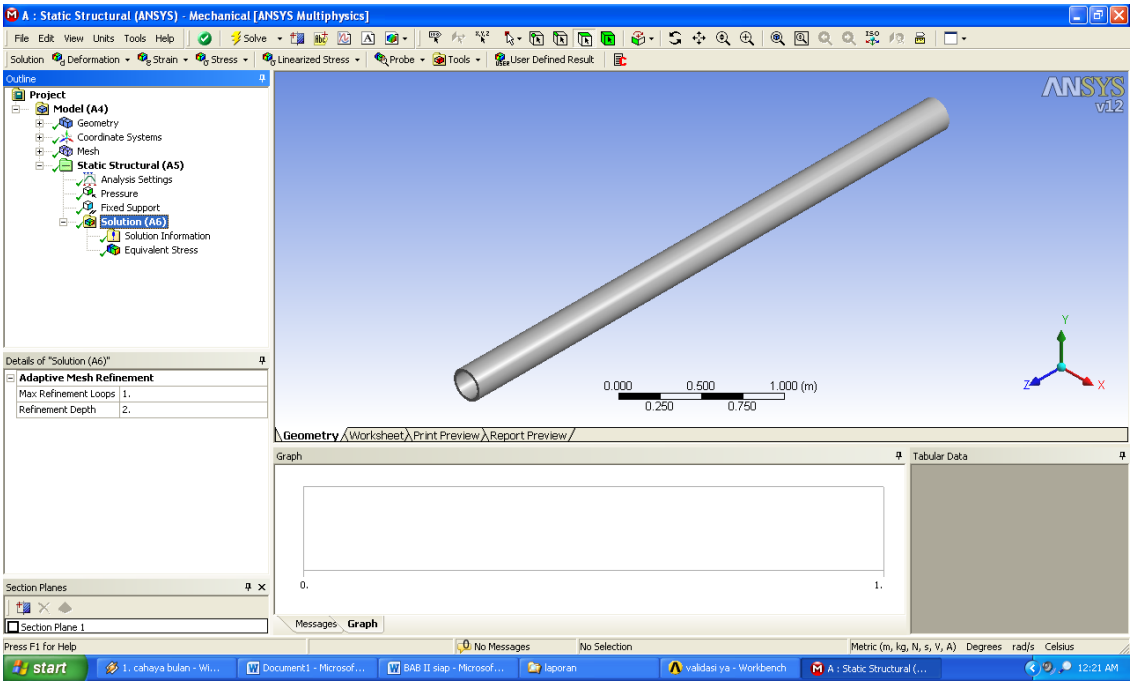
CODE STRESS CHECK PASSED :LOADCASE 1 (SUS) W+P1

Highest Stresses: ( KPa )
CodeStress Ratio: 22.1 @Node 10
Code Stress: 25488.0 Allowable: 115142.4
Axial Stress: 23177.5 @Node 20
Bending Stress: 2310.5 @Node 20
Torsion Stress: 0.0 @Node 20
Hoop Stress: 51731.4 @Node 20
3D Max Intensity: 70355.0 @Node 20

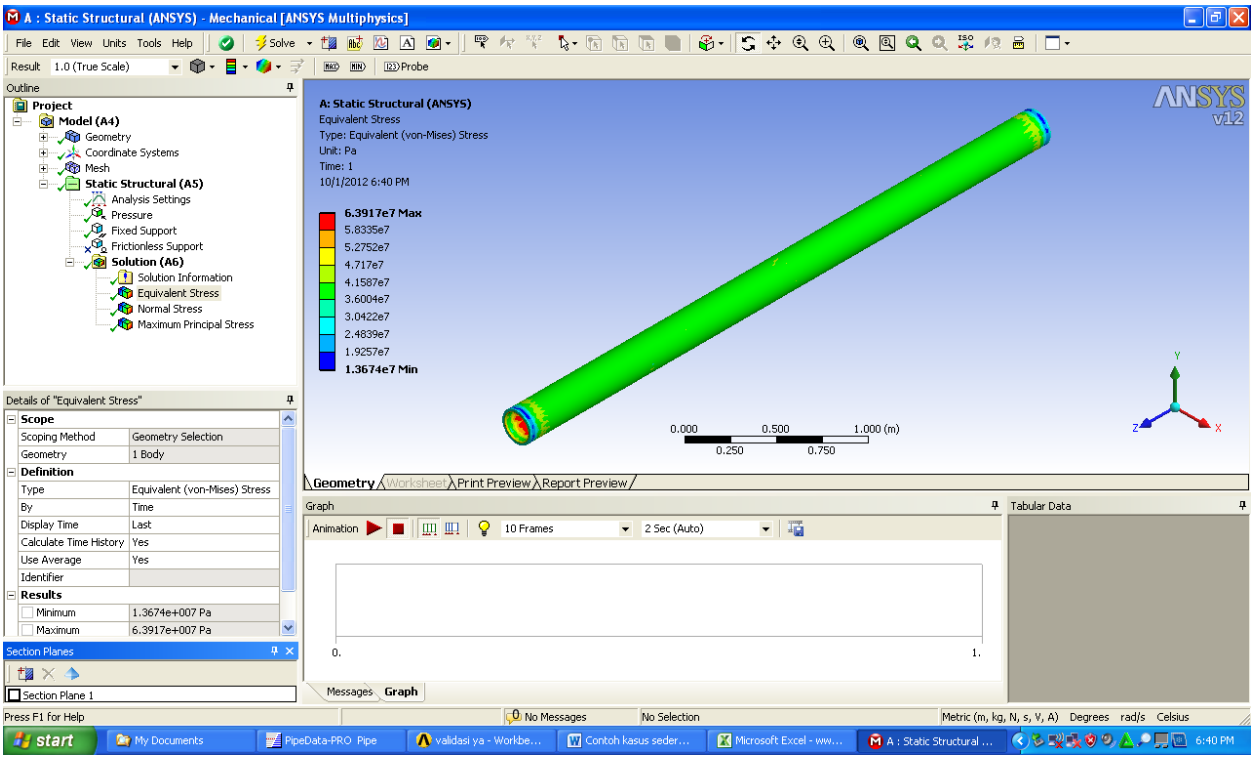
| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| 10 | 23177.5 | 2310.5 | 0.0 | 51731.4 | 70355.0 | 1.000 | 1.000 | 25488.0 | 115142.4 | 22.1 |
| 20 | 23177.5 | 2310.5 | 0.0 | 51731.4 | 70355.0 | 1.000 | 1.000 | 25488.0 | 115142.4 | 22.1 |

- Menggunakan *software* ANSYS Workbench 12

Import geometri dari solidwork 2007 ke ANSYS Workbench 12



solusi




**Nilai tegangan sirkumferensial (σ H)**

| **Perhitungan** | **Nilai Tegangan** | ***Error* (%)** |
|---|---|---|
| Perhitungan manual | 62,57 MPa | 0 |
| CAESAR | 64,37 MPa | 2,79 |
| ANSYS Wrkbench 12 (von-misses) | 63,92 MPa | 2,11 |