



# SEITENDRUCKVERSUCH

|                    |                            |             |                                |
|--------------------|----------------------------|-------------|--------------------------------|
| Projektbezeichnung | : Rhein-Main-Link, PFA HE3 |             |                                |
| Bohrung            | : P07-But-BK-0113          | Formation   | :                              |
| Versuchstiefe      | : 11.00 m                  | Gestein     | :                              |
| Datum              | : 25.03.25                 | Sondentyp   | : Ettlinger Seitendruck 146 mm |
| Gerätenummer       | : 44/67                    | Sondenlänge | : 490 mm                       |
| Messrichtung       | :                          |             |                                |
| Bemerkung          | :                          |             |                                |

| Laststufe | Zeit  | Druck                | Sensor | Sensor | Verformung | Verformung | mittlere   |
|-----------|-------|----------------------|--------|--------|------------|------------|------------|
| A=Anfang  | [Min] |                      | unten  | oben   | unten      | oben       | Verformung |
| E=Ende    |       | [kN/m <sup>2</sup> ] | [mm]   | [mm]   | [mm]       | [mm]       | [mm]       |
| A         | 0     | 101                  | 2.041  | 6.185  | 0.000      | 0.000      | 0.000      |
| E         | 1     | 101                  | 2.313  | 6.282  | 0.272      | 0.097      | 0.184      |
| A         | 2     | 150                  | 3.237  | 6.517  | 1.196      | 0.332      | 0.764      |
| E         | 3     | 150                  | 3.430  | 6.567  | 1.389      | 0.382      | 0.886      |
| A         | 4     | 201                  | 4.428  | 6.812  | 2.387      | 0.627      | 1.507      |
| E         | 5     | 201                  | 4.632  | 6.861  | 2.591      | 0.676      | 1.633      |
| A         | 5     | 251                  | 5.556  | 7.086  | 3.515      | 0.901      | 2.208      |
| E         | 6     | 251                  | 5.792  | 7.128  | 3.751      | 0.943      | 2.347      |
| A         | 7     | 300                  | 6.624  | 7.318  | 4.583      | 1.133      | 2.858      |
| E         | 12    | 300                  | 6.913  | 7.364  | 4.872      | 1.179      | 3.026      |
| A         | 12    | 249                  | 6.906  | 7.363  | 4.865      | 1.178      | 3.022      |
| E         | 13    | 249                  | 6.905  | 7.362  | 4.864      | 1.177      | 3.021      |
| A         | 14    | 199                  | 6.889  | 7.360  | 4.848      | 1.175      | 3.012      |
| E         | 15    | 199                  | 6.879  | 7.358  | 4.838      | 1.173      | 3.006      |
| A         | 16    | 150                  | 6.759  | 7.356  | 4.718      | 1.171      | 2.945      |
| E         | 17    | 150                  | 6.733  | 7.355  | 4.692      | 1.170      | 2.931      |
| A         | 17    | 101                  | 6.458  | 7.302  | 4.417      | 1.117      | 2.767      |
| E         | 24    | 101                  | 6.188  | 7.221  | 4.147      | 1.036      | 2.592      |
| A         | 24    | 150                  | 6.229  | 7.228  | 4.188      | 1.043      | 2.616      |
| E         | 25    | 150                  | 6.255  | 7.230  | 4.214      | 1.045      | 2.630      |
| A         | 26    | 201                  | 6.460  | 7.233  | 4.419      | 1.048      | 2.734      |
| E         | 27    | 201                  | 6.503  | 7.234  | 4.462      | 1.049      | 2.755      |
| A         | 27    | 249                  | 6.722  | 7.286  | 4.681      | 1.101      | 2.891      |
| E         | 28    | 249                  | 6.780  | 7.299  | 4.739      | 1.114      | 2.927      |
| A         | 29    | 299                  | 7.020  | 7.377  | 4.979      | 1.192      | 3.086      |
| E         | 30    | 299                  | 7.148  | 7.401  | 5.107      | 1.216      | 3.162      |
| A         | 30    | 376                  | 7.748  | 7.565  | 5.707      | 1.380      | 3.544      |
| E         | 31    | 376                  | 7.850  | 7.583  | 5.809      | 1.398      | 3.604      |
| A         | 32    | 450                  | 8.163  | 7.661  | 6.122      | 1.476      | 3.799      |
| E         | 33    | 450                  | 8.326  | 7.678  | 6.285      | 1.493      | 3.889      |
| A         | 33    | 526                  | 8.543  | 7.719  | 6.502      | 1.534      | 4.018      |
| E         | 34    | 526                  | 8.662  | 7.730  | 6.621      | 1.545      | 4.083      |
| A         | 35    | 601                  | 8.854  | 7.766  | 6.813      | 1.581      | 4.197      |
| E         | 40    | 601                  | 9.013  | 7.778  | 6.972      | 1.593      | 4.283      |
| A         | 41    | 450                  | 9.005  | 7.777  | 6.964      | 1.592      | 4.278      |
| E         | 42    | 450                  | 8.998  | 7.777  | 6.957      | 1.592      | 4.275      |
| A         | 43    | 300                  | 8.874  | 7.775  | 6.833      | 1.590      | 4.212      |
| E         | 44    | 300                  | 8.855  | 7.774  | 6.814      | 1.589      | 4.202      |
| A         | 44    | 200                  | 8.687  | 7.769  | 6.646      | 1.584      | 4.115      |
| E         | 45    | 200                  | 8.656  | 7.765  | 6.615      | 1.580      | 4.098      |
| A         | 46    | 101                  | 8.152  | 7.595  | 6.111      | 1.410      | 3.761      |
| E         | 51    | 101                  | 8.056  | 7.578  | 6.015      | 1.393      | 3.704      |
| A         | 52    | 200                  | 8.160  | 7.587  | 6.119      | 1.402      | 3.761      |
| E         | 53    | 200                  | 8.179  | 7.588  | 6.138      | 1.403      | 3.771      |



# SEITENDRUCKVERSUCH

|                    |                            |             |                                |
|--------------------|----------------------------|-------------|--------------------------------|
| Projektbezeichnung | : Rhein-Main-Link, PFA HE3 |             |                                |
| Bohrung            | : P07-But-BK-0113          | Formation   | :                              |
| Versuchstiefe      | : 11.00 m                  | Gestein     | :                              |
| Datum              | : 25.03.25                 | Sondentyp   | : Ettlinger Seitendruck 146 mm |
| Gerätenummer       | : 44/67                    | Sondenlänge | : 490 mm                       |
| Messrichtung       | :                          |             |                                |
| Bemerkung          | :                          |             |                                |

| Laststufe | Zeit  | Druck   | Sensor | Sensor | Verformung | Verformung | mittlere   |
|-----------|-------|---------|--------|--------|------------|------------|------------|
| A=Anfang  | [Min] |         | unten  | oben   | unten      | oben       | Verformung |
| E=Ende    |       | [kN/m2] | [mm]   | [mm]   | [mm]       | [mm]       | [mm]       |
| A         | 53    | 299     | 8.458  | 7.625  | 6.417      | 1.440      | 3.929      |
| E         | 54    | 299     | 8.500  | 7.633  | 6.459      | 1.448      | 3.954      |
| A         | 55    | 451     | 8.813  | 7.714  | 6.772      | 1.529      | 4.151      |
| E         | 56    | 451     | 8.870  | 7.721  | 6.829      | 1.536      | 4.183      |
| A         | 57    | 600     | 9.207  | 7.786  | 7.166      | 1.601      | 4.384      |
| E         | 58    | 600     | 9.247  | 7.789  | 7.206      | 1.604      | 4.405      |
| A         | 58    | 701     | 9.428  | 7.824  | 7.387      | 1.639      | 4.513      |
| E         | 59    | 701     | 9.502  | 7.831  | 7.461      | 1.646      | 4.554      |
| A         | 60    | 800     | 9.667  | 7.868  | 7.626      | 1.683      | 4.655      |
| E         | 61    | 800     | 9.706  | 7.872  | 7.665      | 1.687      | 4.676      |
| A         | 61    | 900     | 9.834  | 7.902  | 7.793      | 1.717      | 4.755      |
| E         | 62    | 900     | 9.903  | 7.908  | 7.862      | 1.723      | 4.793      |
| A         | 63    | 1000    | 10.051 | 7.947  | 8.010      | 1.762      | 4.886      |
| E         | 64    | 1000    | 10.080 | 7.947  | 8.039      | 1.762      | 4.901      |
| A         | 65    | 1100    | 10.173 | 7.977  | 8.132      | 1.792      | 4.962      |
| E         | 70    | 1100    | 10.266 | 7.986  | 8.225      | 1.801      | 5.013      |
| A         | 70    | 699     | 10.112 | 7.982  | 8.071      | 1.797      | 4.934      |
| E         | 71    | 699     | 10.094 | 7.981  | 8.053      | 1.796      | 4.925      |
| A         | 72    | 398     | 9.769  | 7.950  | 7.728      | 1.765      | 4.747      |
| E         | 73    | 398     | 9.751  | 7.943  | 7.710      | 1.758      | 4.734      |
| A         | 74    | 249     | 9.560  | 7.881  | 7.519      | 1.696      | 4.608      |
| E         | 75    | 249     | 9.511  | 7.874  | 7.470      | 1.689      | 4.580      |
| A         | 77    | 98      | 9.047  | 7.745  | 7.006      | 1.560      | 4.283      |
| E         | 82    | 98      | 8.487  | 7.602  | 6.446      | 1.417      | 3.931      |



# SEITENDRUCKVERSUCH

|                    |                            |             |                                |
|--------------------|----------------------------|-------------|--------------------------------|
| Projektbezeichnung | : Rhein-Main-Link, PFA HE3 |             |                                |
| Bohrung            | : P07-But-BK-0113          | Formation   | :                              |
| Versuchstiefe      | : 11.00 m                  | Gestein     | :                              |
| Datum              | : 25.03.25                 | Sondentyp   | : Ettlinger Seitendruck 146 mm |
| Gerätenummer       | : 44/67                    | Sondenlänge | : 490 mm                       |
| Messrichtung       | :                          |             |                                |
| Bemerkung          | :                          |             |                                |

## MODULI aus der unteren Verformung :

|               | Lastbereich<br>[kN/m <sup>2</sup> ] | Verschiebung<br>[mm] | Ermittelte Moduli bei unterschiedlichen Poissonszahlen |                                |                               |                               |                               |                               |
|---------------|-------------------------------------|----------------------|--------------------------------------------------------|--------------------------------|-------------------------------|-------------------------------|-------------------------------|-------------------------------|
|               |                                     |                      | Steifemodul in Klammern                                |                                |                               |                               |                               |                               |
|               |                                     |                      | v=0,25<br>[MN/m <sup>2</sup> ]                         | v=0,25<br>[MN/m <sup>2</sup> ] | v=0,3<br>[MN/m <sup>2</sup> ] | v=0,3<br>[MN/m <sup>2</sup> ] | v=0,4<br>[MN/m <sup>2</sup> ] | v=0,4<br>[MN/m <sup>2</sup> ] |
| Belastung     | 101 - 300                           | 4.600                | 6.1                                                    |                                | 6.0                           |                               | 5.7                           |                               |
| Entlastung    | 240 - 161                           | -0.137               | 81.5                                                   | (97.7)                         | 80.5                          | (108.4)                       | 76.2                          | (163.3)                       |
| Belastung     | 101 - 601                           | 2.825                | 24.8                                                   |                                | 24.5                          |                               | 23.2                          |                               |
| Entlastung    | 451 - 251                           | -0.241               | 116.5                                                  | (139.8)                        | 115.1                         | (155.0)                       | 109.0                         | (233.5)                       |
| Belastung     | 101 - 1100                          | 2.210                | 63.3                                                   |                                | 62.6                          |                               | 59.3                          |                               |
| Entlastung    | 799 - 399                           | -0.385               | 145.7                                                  | (174.8)                        | 144.0                         | (193.9)                       | 136.3                         | (292.1)                       |
| Erstbelastung | 101 - 300                           | 4.600                | 6.1                                                    |                                | 6.0                           |                               | 5.7                           |                               |
| Erstbelastung | 299 - 601                           | 1.865                | 22.6                                                   |                                | 22.4                          |                               | 21.2                          |                               |
| Erstbelastung | 600 - 1100                          | 1.019                | 68.8                                                   |                                | 68.0                          |                               | 64.4                          |                               |
| Wiederbelast. | 101 - 299                           | 0.960                | 29.0                                                   |                                | 28.6                          |                               | 27.1                          |                               |
| Wiederbelast. | 101 - 600                           | 1.191                | 58.7                                                   |                                | 58.0                          |                               | 54.9                          |                               |

## MODULI aus der oberen Verformung :

|               |            |        |        |          |        |          |        |          |
|---------------|------------|--------|--------|----------|--------|----------|--------|----------|
| Belastung     | 101 - 300  | 1.082  | 25.7   |          | 25.4   |          | 24.1   |          |
| Entlastung    | 240 - 161  | -0.006 | 1979   | (2374.8) | 1956.3 | (2633.5) | 1851.2 | (3966.9) |
| Belastung     | 101 - 601  | 0.557  | 125.7  |          | 124.3  |          | 117.6  |          |
| Entlastung    | 451 - 251  | -0.007 | 3778.9 | (4534.7) | 3735.6 | (5028.7) | 3534.9 | (7574.7) |
| Belastung     | 101 - 1100 | 0.408  | 343.1  |          | 339.2  |          | 321    |          |
| Entlastung    | 799 - 399  | -0.039 | 1433.1 | (1719.7) | 1416.6 | (1907.0) | 1340.5 | (2872.5) |
| Erstbelastung | 101 - 300  | 1.082  | 25.7   |          | 25.4   |          | 24.1   |          |
| Erstbelastung | 299 - 601  | 0.377  | 112.0  |          | 110.7  |          | 104.7  |          |
| Erstbelastung | 600 - 1100 | 0.197  | 355.9  |          | 351.8  |          | 332.9  |          |
| Wiederbelast. | 101 - 299  | 0.180  | 154.6  |          | 152.8  |          | 144.6  |          |
| Wiederbelast. | 101 - 600  | 0.211  | 331.2  |          | 327.5  |          | 309.9  |          |



# SEITENDRUCKVERSUCH

|                    |                            |             |                                |
|--------------------|----------------------------|-------------|--------------------------------|
| Projektbezeichnung | : Rhein-Main-Link, PFA HE3 |             |                                |
| Bohrung            | : P07-But-BK-0113          | Formation   | :                              |
| Versuchstiefe      | : 11.00 m                  | Gestein     | :                              |
| Datum              | : 25.03.25                 | Sondentyp   | : Ettlinger Seitendruck 146 mm |
| Gerätenummer       | : 44/67                    | Sondenlänge | : 490 mm                       |
| Messrichtung       | :                          |             |                                |
| Bemerkung          | :                          |             |                                |

## MODULI aus der mittleren Verformung :

|               | Lastbereich<br>[kN/m <sup>2</sup> ] | Verschiebung<br>[mm] | Ermittelte Moduli bei unterschiedlichen Poissonzahlen |                                |                               |                               |                               |                               |
|---------------|-------------------------------------|----------------------|-------------------------------------------------------|--------------------------------|-------------------------------|-------------------------------|-------------------------------|-------------------------------|
|               |                                     |                      | Steifemodul in Klammern                               |                                |                               |                               |                               |                               |
|               |                                     |                      | v=0,25<br>[MN/m <sup>2</sup> ]                        | v=0,25<br>[MN/m <sup>2</sup> ] | v=0,3<br>[MN/m <sup>2</sup> ] | v=0,3<br>[MN/m <sup>2</sup> ] | v=0,4<br>[MN/m <sup>2</sup> ] | v=0,4<br>[MN/m <sup>2</sup> ] |
| Belastung     | 101 - 300                           | 2.841                | 9.8                                                   |                                | 9.7                           |                               | 9.2                           |                               |
| Entlastung    | 240 - 161                           | -0.071               | 156.5                                                 | (187.8)                        | 154.7                         | (208.2)                       | 146.4                         | (313.6)                       |
| Belastung     | 101 - 601                           | 1.691                | 41.4                                                  |                                | 40.9                          |                               | 38.7                          |                               |
| Entlastung    | 451 - 251                           | -0.124               | 226.0                                                 | (271.2)                        | 223.4                         | (300.7)                       | 211.4                         | (453.0)                       |
| Belastung     | 101 - 1100                          | 1.309                | 106.9                                                 |                                | 105.7                         |                               | 100.0                         |                               |
| Entlastung    | 799 - 399                           | -0.212               | 264.5                                                 | (317.4)                        | 261.5                         | (352.0)                       | 247.4                         | (530.2)                       |
| Erstbelastung | 101 - 300                           | 2.841                | 9.8                                                   |                                | 9.7                           |                               | 9.2                           |                               |
| Erstbelastung | 299 - 601                           | 1.121                | 37.7                                                  |                                | 37.2                          |                               | 35.2                          |                               |
| Erstbelastung | 600 - 1100                          | 0.608                | 115.3                                                 |                                | 114.0                         |                               | 107.9                         |                               |
| Wiederbelast. | 101 - 299                           | 0.570                | 48.8                                                  |                                | 48.3                          |                               | 45.7                          |                               |
| Wiederbelast. | 101 - 600                           | 0.701                | 99.7                                                  |                                | 98.6                          |                               | 93.3                          |                               |

## FORMELN :

Gleichung für die Modulberechnung:

$$E = f \times d \times \frac{\Delta p}{\Delta d}$$

f (für Poissonzahl 0,25)= 0.960

f (für Poissonzahl 0,30)= 0.949

f (für Poissonzahl 0,40)= 0.898

d = 146 mm Anfangsdurchmesser der Versuchsbohrung

delta p = Änderung der Bodenpressung

delta v = Änderung des Durchmessers

Modulberechnungen nach DIN 22476-7



# SEITENDRUCKVERSUCH

|                    |                            |             |                                |
|--------------------|----------------------------|-------------|--------------------------------|
| Projektbezeichnung | : Rhein-Main-Link, PFA HE3 |             |                                |
| Bohrung            | : P07-But-BK-0113          | Formation   | :                              |
| Versuchstiefe      | : 11.00 m                  | Gestein     | :                              |
| Datum              | : 25.03.25                 | Sondentyp   | : Ettlinger Seitendruck 146 mm |
| Gerätenummer       | : 44/67                    | Sondenlänge | : 490 mm                       |
| Messrichtung       | :                          |             |                                |
| Bemerkung          | :                          |             |                                |

