



# SEITENDRUCKVERSUCH

|                    |                            |             |                                |
|--------------------|----------------------------|-------------|--------------------------------|
| Projektbezeichnung | : Rhein-Main-Link, PFA HE3 |             |                                |
| Bohrung            | : P07-But-BK-0130          | Formation   | :                              |
| Versuchstiefe      | : 2.00 m                   | Gestein     | :                              |
| Datum              | : 18.11.24                 | Sondentyp   | : Ettlinger Seitendruck 146 mm |
| Gerätenummer       | : 16/44                    | 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     | 100                  | 2.487  | 1.121  | 0.000      | 0.000      | 0.000      |
| E         | 3     | 100                  | 3.303  | 1.329  | 0.816      | 0.208      | 0.512      |
| A         | 4     | 200                  | 5.994  | 2.183  | 3.507      | 1.062      | 2.285      |
| E         | 5     | 200                  | 6.745  | 2.354  | 4.258      | 1.233      | 2.746      |
| A         | 5     | 300                  | 9.185  | 3.041  | 6.698      | 1.920      | 4.309      |
| E         | 10    | 300                  | 11.363 | 3.576  | 8.876      | 2.455      | 5.666      |
| A         | 11    | 201                  | 11.316 | 3.562  | 8.829      | 2.441      | 5.635      |
| E         | 12    | 201                  | 11.312 | 3.560  | 8.825      | 2.439      | 5.632      |
| A         | 12    | 101                  | 11.270 | 3.398  | 8.783      | 2.277      | 5.530      |
| E         | 15    | 101                  | 11.204 | 3.350  | 8.717      | 2.229      | 5.473      |
| A         | 15    | 201                  | 11.242 | 3.383  | 8.755      | 2.262      | 5.509      |
| E         | 16    | 201                  | 11.246 | 3.396  | 8.759      | 2.275      | 5.517      |
| A         | 17    | 301                  | 11.365 | 3.586  | 8.878      | 2.465      | 5.672      |
| E         | 18    | 301                  | 11.593 | 3.631  | 9.106      | 2.510      | 5.808      |
| A         | 18    | 400                  | 13.060 | 4.036  | 10.573     | 2.915      | 6.744      |
| E         | 19    | 400                  | 14.237 | 4.340  | 11.750     | 3.219      | 7.484      |
| A         | 19    | 500                  | 16.568 | 4.879  | 14.081     | 3.758      | 8.920      |
| E         | 20    | 500                  | 18.570 | 5.360  | 16.083     | 4.239      | 10.161     |
| A         | 21    | 600                  | 21.117 | 5.956  | 18.630     | 4.835      | 11.732     |
| E         | 26    | 600                  | 25.141 | 6.799  | 22.654     | 5.678      | 14.166     |
| A         | 26    | 299                  | 25.077 | 6.614  | 22.590     | 5.493      | 14.042     |
| E         | 27    | 299                  | 25.074 | 6.609  | 22.587     | 5.488      | 14.038     |
| A         | 27    | 201                  | 24.876 | 6.429  | 22.389     | 5.308      | 13.848     |
| E         | 28    | 201                  | 24.783 | 6.401  | 22.296     | 5.280      | 13.788     |
| A         | 29    | 100                  | 24.307 | 6.167  | 21.820     | 5.046      | 13.433     |
| E         | 32    | 100                  | 23.983 | 6.072  | 21.496     | 4.951      | 13.224     |
| A         | 32    | 201                  | 23.993 | 6.085  | 21.506     | 4.964      | 13.235     |
| E         | 33    | 201                  | 24.002 | 6.089  | 21.515     | 4.968      | 13.242     |
| A         | 34    | 400                  | 24.239 | 6.423  | 21.752     | 5.302      | 13.527     |
| E         | 35    | 400                  | 24.348 | 6.449  | 21.861     | 5.328      | 13.594     |
| A         | 35    | 600                  | 25.770 | 6.981  | 23.283     | 5.860      | 14.572     |
| E         | 36    | 600                  | 26.339 | 7.079  | 23.852     | 5.958      | 14.905     |
| A         | 36    | 700                  | 27.306 | 7.313  | 24.819     | 6.192      | 15.506     |
| E         | 37    | 700                  | 29.042 | 7.681  | 26.555     | 6.560      | 16.557     |
| A         | 38    | 800                  | 31.575 | 8.232  | 29.088     | 7.111      | 18.100     |
| E         | 39    | 800                  | 33.790 | 8.728  | 31.303     | 7.607      | 19.455     |
| A         | 39    | 901                  | 36.373 | 9.279  | 33.886     | 8.158      | 21.022     |
| E         | 44    | 901                  | 38.860 | 9.943  | 36.373     | 8.822      | 22.597     |
| A         | 45    | 501                  | 38.735 | 9.847  | 36.248     | 8.726      | 22.487     |
| E         | 46    | 501                  | 38.731 | 9.841  | 36.244     | 8.720      | 22.482     |
| A         | 46    | 199                  | 38.312 | 9.298  | 35.825     | 8.177      | 22.001     |
| E         | 47    | 199                  | 38.188 | 9.245  | 35.701     | 8.124      | 21.912     |
| A         | 47    | 101                  | 37.741 | 9.024  | 35.254     | 7.903      | 21.578     |
| E         | 50    | 101                  | 37.341 | 8.854  | 34.854     | 7.733      | 21.293     |



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| Bohrung            | : P07-But-BK-0130          | Formation   | :                              |
| Versuchstiefe      | : 2.00 m                   | Gestein     | :                              |
| Datum              | : 18.11.24                 | Sondentyp   | : Ettlinger Seitendruck 146 mm |
| Gerätenummer       | : 16/44                    | Sondenlänge | : 490 mm                       |
| Messrichtung       | :                          |             |                                |
| Bemerkung          | :                          |             |                                |

## MODULI aus der unteren 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     | 100 - 300                           | 8.060                | 3.5                                                   |                                | 3.4                           |                               | 3.3                           |                               |
| Entlastung    | 240 - 160                           | -0.064               | 174.6                                                 | (209.5)                        | 172.6                         | (232.4)                       | 163.3                         | (350.0)                       |
| Belastung     | 101 - 600                           | 13.937               | 5.0                                                   |                                | 5.0                           |                               | 4.7                           |                               |
| Entlastung    | 450 - 251                           | -0.179               | 156.5                                                 | (187.8)                        | 154.7                         | (208.3)                       | 146.4                         | (313.7)                       |
| Belastung     | 100 - 901                           | 14.877               | 7.5                                                   |                                | 7.5                           |                               | 7.1                           |                               |
| Entlastung    | 661 - 341                           | -0.340               | 132.0                                                 | (158.5)                        | 130.5                         | (175.7)                       | 123.5                         | (264.7)                       |
| Erstbelastung | 100 - 300                           | 8.060                | 3.5                                                   |                                | 3.4                           |                               | 3.3                           |                               |
| Erstbelastung | 301 - 600                           | 13.548               | 3.1                                                   |                                | 3.1                           |                               | 2.9                           |                               |
| Erstbelastung | 600 - 901                           | 12.521               | 3.4                                                   |                                | 3.3                           |                               | 3.1                           |                               |
| Wiederbelast. | 101 - 301                           | 0.389                | 72.0                                                  |                                | 71.1                          |                               | 67.3                          |                               |
| Wiederbelast. | 100 - 600                           | 2.356                | 29.7                                                  |                                | 29.4                          |                               | 27.8                          |                               |

## MODULI aus der oberen Verformung :

|               |           |        |       |         |       |         |       |         |
|---------------|-----------|--------|-------|---------|-------|---------|-------|---------|
| Belastung     | 100 - 300 | 2.247  | 12.5  |         | 12.3  |         | 11.7  |         |
| Entlastung    | 240 - 160 | -0.091 | 122.1 | (146.5) | 120.7 | (162.5) | 114.2 | (244.8) |
| Belastung     | 101 - 600 | 3.449  | 20.3  |         | 20.1  |         | 19    |         |
| Entlastung    | 450 - 251 | -0.199 | 140.6 | (168.8) | 139   | (187.2) | 131.6 | (281.9) |
| Belastung     | 100 - 901 | 3.871  | 29    |         | 28.6  |         | 27.1  |         |
| Entlastung    | 661 - 341 | -0.357 | 125.6 | (150.7) | 124.2 | (167.2) | 117.5 | (251.8) |
| Erstbelastung | 100 - 300 | 2.247  | 12.5  |         | 12.3  |         | 11.7  |         |
| Erstbelastung | 301 - 600 | 3.168  | 13.3  |         | 13.1  |         | 12.4  |         |
| Erstbelastung | 600 - 901 | 2.864  | 14.7  |         | 14.5  |         | 13.7  |         |
| Wiederbelast. | 101 - 301 | 0.281  | 99.6  |         | 98.5  |         | 93.2  |         |
| Wiederbelast. | 100 - 600 | 1.007  | 69.6  |         | 68.8  |         | 65.1  |         |



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| Bohrung            | : P07-But-BK-0130          | Formation   | :                              |
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| Datum              | : 18.11.24                 | Sondentyp   | : Ettlinger Seitendruck 146 mm |
| Gerätenummer       | : 16/44                    | 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     | 100 - 300                           | 5.154                | 5.4                                                   |                                | 5.4                           |                               | 5.1                           |                               |
| Entlastung    | 240 - 160                           | -0.078               | 143.7                                                 | (172.5)                        | 142.1                         | (191.3)                       | 134.4                         | (288.1)                       |
| Belastung     | 101 - 600                           | 8.693                | 8.1                                                   |                                | 8.0                           |                               | 7.5                           |                               |
| Entlastung    | 450 - 251                           | -0.189               | 148.2                                                 | (177.8)                        | 146.5                         | (197.1)                       | 138.6                         | (297.0)                       |
| Belastung     | 100 - 901                           | 9.374                | 12.0                                                  |                                | 11.8                          |                               | 11.2                          |                               |
| Entlastung    | 661 - 341                           | -0.348               | 128.8                                                 | (154.5)                        | 127.3                         | (171.3)                       | 120.4                         | (258.1)                       |
| Erstbelastung | 100 - 300                           | 5.154                | 5.4                                                   |                                | 5.4                           |                               | 5.1                           |                               |
| Erstbelastung | 301 - 600                           | 8.358                | 5.0                                                   |                                | 5.0                           |                               | 4.7                           |                               |
| Erstbelastung | 600 - 901                           | 7.693                | 5.5                                                   |                                | 5.4                           |                               | 5.1                           |                               |
| Wiederbelast. | 101 - 301                           | 0.335                | 83.6                                                  |                                | 82.6                          |                               | 78.2                          |                               |
| Wiederbelast. | 100 - 600                           | 1.681                | 41.7                                                  |                                | 41.2                          |                               | 39.0                          |                               |

## 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



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