



# SEITENDRUCKVERSUCH

|                    |                            |             |                                |
|--------------------|----------------------------|-------------|--------------------------------|
| Projektbezeichnung | : Rhein-Main-Link, PFA HE3 |             |                                |
| Bohrung            | : P07-Sta-BK-0181          | Formation   | :                              |
| Versuchstiefe      | : 11.50 m                  | Gestein     | :                              |
| Datum              | : 06.11.25                 | Sondentyp   | : Ettlinger Seitendruck 146 mm |
| Gerätenummer       | : 40/66                    | 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     | 25                   | 1.040  | 3.016  | 0.000      | 0.000      | 0.000      |
| E         | 1     | 25                   | 1.751  | 4.146  | 0.711      | 1.130      | 0.921      |
| A         | 1     | 50                   | 2.607  | 5.104  | 1.567      | 2.088      | 1.827      |
| E         | 2     | 50                   | 3.057  | 5.620  | 2.017      | 2.604      | 2.311      |
| A         | 3     | 75                   | 3.637  | 6.132  | 2.597      | 3.116      | 2.856      |
| E         | 4     | 75                   | 3.867  | 6.412  | 2.827      | 3.396      | 3.111      |
| A         | 4     | 101                  | 4.380  | 6.891  | 3.340      | 3.875      | 3.608      |
| E         | 9     | 101                  | 4.514  | 7.015  | 3.474      | 3.999      | 3.737      |
| A         | 10    | 75                   | 4.511  | 7.014  | 3.471      | 3.998      | 3.735      |
| E         | 11    | 75                   | 4.509  | 7.013  | 3.469      | 3.997      | 3.733      |
| A         | 12    | 51                   | 4.480  | 7.010  | 3.440      | 3.994      | 3.717      |
| E         | 13    | 51                   | 4.473  | 7.010  | 3.433      | 3.994      | 3.714      |
| A         | 14    | 25                   | 4.363  | 7.004  | 3.323      | 3.988      | 3.656      |
| E         | 17    | 25                   | 4.360  | 7.000  | 3.320      | 3.984      | 3.652      |
| A         | 18    | 51                   | 4.408  | 7.001  | 3.368      | 3.985      | 3.677      |
| E         | 19    | 51                   | 4.408  | 7.002  | 3.368      | 3.986      | 3.677      |
| A         | 19    | 74                   | 4.446  | 7.002  | 3.406      | 3.986      | 3.696      |
| E         | 20    | 74                   | 4.464  | 7.003  | 3.424      | 3.987      | 3.706      |
| A         | 20    | 100                  | 4.544  | 7.034  | 3.504      | 4.018      | 3.761      |
| E         | 21    | 100                  | 4.561  | 7.045  | 3.521      | 4.029      | 3.775      |
| A         | 22    | 150                  | 5.180  | 7.580  | 4.140      | 4.564      | 4.352      |
| E         | 23    | 150                  | 5.300  | 7.687  | 4.260      | 4.671      | 4.466      |
| A         | 24    | 200                  | 5.875  | 8.210  | 4.835      | 5.194      | 5.015      |
| E         | 25    | 200                  | 5.989  | 8.325  | 4.949      | 5.309      | 5.129      |
| A         | 25    | 250                  | 6.428  | 8.727  | 5.388      | 5.711      | 5.550      |
| E         | 30    | 250                  | 6.608  | 8.904  | 5.568      | 5.888      | 5.728      |
| A         | 31    | 150                  | 6.552  | 8.900  | 5.512      | 5.884      | 5.698      |
| E         | 32    | 150                  | 6.549  | 8.899  | 5.509      | 5.883      | 5.696      |
| A         | 32    | 101                  | 6.442  | 8.882  | 5.402      | 5.866      | 5.634      |
| E         | 33    | 101                  | 6.432  | 8.878  | 5.392      | 5.862      | 5.627      |
| A         | 38    | 75                   | 6.382  | 8.808  | 5.342      | 5.792      | 5.567      |
| E         | 39    | 75                   | 6.375  | 8.802  | 5.335      | 5.786      | 5.560      |
| A         | 39    | 51                   | 6.291  | 8.718  | 5.251      | 5.702      | 5.476      |
| E         | 40    | 51                   | 6.271  | 8.703  | 5.231      | 5.687      | 5.459      |
| A         | 41    | 25                   | 6.138  | 8.559  | 5.098      | 5.543      | 5.321      |
| E         | 44    | 25                   | 6.124  | 8.553  | 5.084      | 5.537      | 5.311      |
| A         | 45    | 51                   | 6.155  | 8.559  | 5.115      | 5.543      | 5.329      |
| E         | 46    | 51                   | 6.157  | 8.559  | 5.117      | 5.543      | 5.330      |
| A         | 46    | 76                   | 6.187  | 8.560  | 5.147      | 5.544      | 5.346      |
| E         | 47    | 76                   | 6.196  | 8.562  | 5.156      | 5.546      | 5.351      |
| A         | 48    | 101                  | 6.248  | 8.569  | 5.208      | 5.553      | 5.381      |
| E         | 49    | 101                  | 6.263  | 8.576  | 5.223      | 5.560      | 5.392      |
| A         | 49    | 150                  | 6.396  | 8.704  | 5.356      | 5.688      | 5.522      |
| E         | 50    | 150                  | 6.405  | 8.709  | 5.365      | 5.693      | 5.529      |



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|--------------------|----------------------------|-------------|--------------------------------|
| Projektbezeichnung | : Rhein-Main-Link, PFA HE3 |             |                                |
| Bohrung            | : P07-Sta-BK-0181          | Formation   | :                              |
| Versuchstiefe      | : 11.50 m                  | Gestein     | :                              |
| Datum              | : 06.11.25                 | Sondentyp   | : Ettlinger Seitendruck 146 mm |
| Gerätenummer       | : 40/66                    | 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         | 51    | 251     | 6.762  | 9.030  | 5.722      | 6.014      | 5.868      |
| E         | 52    | 251     | 6.821  | 9.090  | 5.781      | 6.074      | 5.928      |
| A         | 53    | 300     | 7.145  | 9.383  | 6.105      | 6.367      | 6.236      |
| E         | 54    | 300     | 7.186  | 9.413  | 6.146      | 6.397      | 6.272      |
| A         | 54    | 351     | 7.485  | 9.673  | 6.445      | 6.657      | 6.551      |
| E         | 55    | 351     | 7.574  | 9.759  | 6.534      | 6.743      | 6.639      |
| A         | 56    | 400     | 7.785  | 9.962  | 6.745      | 6.946      | 6.846      |
| E         | 61    | 400     | 8.009  | 10.168 | 6.969      | 7.152      | 7.061      |
| A         | 61    | 299     | 7.985  | 10.164 | 6.945      | 7.148      | 7.047      |
| E         | 62    | 299     | 7.982  | 10.164 | 6.942      | 7.148      | 7.045      |
| A         | 63    | 201     | 7.860  | 10.162 | 6.820      | 7.146      | 6.983      |
| E         | 64    | 201     | 7.854  | 10.161 | 6.814      | 7.145      | 6.980      |
| A         | 64    | 150     | 7.779  | 10.098 | 6.739      | 7.082      | 6.911      |
| E         | 65    | 150     | 7.756  | 10.076 | 6.716      | 7.060      | 6.888      |
| A         | 66    | 100     | 7.648  | 9.968  | 6.608      | 6.952      | 6.780      |
| E         | 67    | 100     | 7.635  | 9.946  | 6.595      | 6.930      | 6.763      |
| A         | 67    | 74      | 7.567  | 9.883  | 6.527      | 6.867      | 6.697      |
| E         | 68    | 74      | 7.541  | 9.858  | 6.501      | 6.842      | 6.671      |
| A         | 68    | 51      | 7.463  | 9.772  | 6.423      | 6.756      | 6.590      |
| E         | 69    | 51      | 7.439  | 9.745  | 6.399      | 6.729      | 6.564      |
| A         | 70    | 25      | 7.281  | 9.587  | 6.241      | 6.571      | 6.406      |
| E         | 73    | 25      | 7.265  | 9.569  | 6.225      | 6.553      | 6.389      |



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| Projektbezeichnung | : Rhein-Main-Link, PFA HE3 |             |                                |
| Bohrung            | : P07-Sta-BK-0181          | Formation   | :                              |
| Versuchstiefe      | : 11.50 m                  | Gestein     | :                              |
| Datum              | : 06.11.25                 | Sondentyp   | : Ettlinger Seitendruck 146 mm |
| Gerätenummer       | : 40/66                    | 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     | 25 - 101                            | 2.763                | 3.9                                                   |                                | 3.8                           |                               | 3.6                           |                               |
| Entlastung    | 78 - 48                             | -0.048               | 88.6                                                  | (106.3)                        | 87.6                          | (117.9)                       | 82.9                          | (177.6)                       |
| Belastung     | 25 - 250                            | 2.248                | 14.0                                                  |                                | 13.9                          |                               | 13.1                          |                               |
| Entlastung    | 183 - 93                            | -0.154               | 81.6                                                  | (97.9)                         | 80.6                          | (108.5)                       | 76.3                          | (163.5)                       |
| Belastung     | 25 - 400                            | 1.885                | 27.9                                                  |                                | 27.6                          |                               | 26.1                          |                               |
| Entlastung    | 288 - 138                           | -0.240               | 87.7                                                  | (105.3)                        | 86.7                          | (116.7)                       | 82.1                          | (175.8)                       |
| Erstbelastung | 25 - 101                            | 2.763                | 3.9                                                   |                                | 3.8                           |                               | 3.6                           |                               |
| Erstbelastung | 100 - 250                           | 2.047                | 10.2                                                  |                                | 10.1                          |                               | 9.6                           |                               |
| Erstbelastung | 251 - 400                           | 1.188                | 17.7                                                  |                                | 17.5                          |                               | 16.5                          |                               |
| Wiederbelast. | 25 - 100                            | 0.201                | 52.5                                                  |                                | 51.9                          |                               | 49.1                          |                               |
| Wiederbelast. | 25 - 251                            | 0.697                | 45.3                                                  |                                | 44.8                          |                               | 42.4                          |                               |

## MODULI aus der oberen Verformung :

|               |           |        |       |          |       |          |       |          |
|---------------|-----------|--------|-------|----------|-------|----------|-------|----------|
| Belastung     | 25 - 101  | 2.869  | 3.7   |          | 3.7   |          | 3.5   |          |
| Entlastung    | 78 - 48   | -0.004 | 998.8 | (1198.6) | 987.4 | (1329.1) | 934.3 | (2002.1) |
| Belastung     | 25 - 250  | 1.904  | 16.5  |          | 16.4  |          | 15.5  |          |
| Entlastung    | 183 - 93  | -0.047 | 268.3 | (322.0)  | 265.2 | (357.0)  | 251   | (537.8)  |
| Belastung     | 25 - 400  | 1.615  | 32.6  |          | 32.2  |          | 30.4  |          |
| Entlastung    | 288 - 138 | -0.119 | 177.3 | (212.7)  | 175.2 | (235.9)  | 165.8 | (355.3)  |
| Erstbelastung | 25 - 101  | 2.869  | 3.7   |          | 3.7   |          | 3.5   |          |
| Erstbelastung | 100 - 250 | 1.859  | 11.3  |          | 11.1  |          | 10.5  |          |
| Erstbelastung | 251 - 400 | 1.078  | 19.5  |          | 19.3  |          | 18.2  |          |
| Wiederbelast. | 25 - 100  | 0.045  | 234.4 |          | 231.7 |          | 219.2 |          |
| Wiederbelast. | 25 - 251  | 0.537  | 58.8  |          | 58.1  |          | 55.0  |          |



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| Bohrung            | : P07-Sta-BK-0181          | Formation   | :                              |
| Versuchstiefe      | : 11.50 m                  | Gestein     | :                              |
| Datum              | : 06.11.25                 | Sondentyp   | : Ettlinger Seitendruck 146 mm |
| Gerätenummer       | : 40/66                    | 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     | 25 - 101                            | 2.816                | 3.8                                                   |                                | 3.7                           |                               | 3.5                           |                               |
| Entlastung    | 78 - 48                             | -0.026               | 162.8                                                 | (195.3)                        | 160.9                         | (216.6)                       | 152.3                         | (326.3)                       |
| Belastung     | 25 - 250                            | 2.076                | 15.2                                                  |                                | 15.0                          |                               | 14.2                          |                               |
| Entlastung    | 183 - 93                            | -0.101               | 125.1                                                 | (150.1)                        | 123.7                         | (166.5)                       | 117.0                         | (250.8)                       |
| Belastung     | 25 - 400                            | 1.750                | 30.0                                                  |                                | 29.7                          |                               | 28.1                          |                               |
| Entlastung    | 288 - 138                           | -0.179               | 117.4                                                 | (140.8)                        | 116.0                         | (156.2)                       | 109.8                         | (235.3)                       |
| Erstbelastung | 25 - 101                            | 2.816                | 3.8                                                   |                                | 3.7                           |                               | 3.5                           |                               |
| Erstbelastung | 100 - 250                           | 1.953                | 10.7                                                  |                                | 10.6                          |                               | 10.0                          |                               |
| Erstbelastung | 251 - 400                           | 1.133                | 18.5                                                  |                                | 18.3                          |                               | 17.3                          |                               |
| Wiederbelast. | 25 - 100                            | 0.123                | 85.7                                                  |                                | 84.8                          |                               | 80.2                          |                               |
| Wiederbelast. | 25 - 251                            | 0.617                | 51.2                                                  |                                | 50.6                          |                               | 47.9                          |                               |

## 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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