**Appendix A Test Database of Precast Recycled Aggregate Concrete**

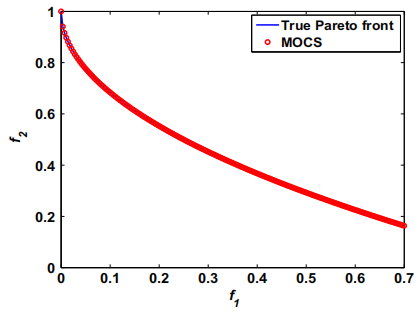
|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Literature | Cement  (kg) | Fly ash  (kg) | Water  (kg) | NFA  (kg) | *θ*NFA  (%) | RFA  (kg) | *η*RFA | *θ*RFA  (%) | NCA  (kg) | *θ*NCA  (%) | RCA  (kg) | *η*RCA | *θ*RCA  (%) | SP  (kg) | *f*cy  (MPa) | *f*st  (MPa) |
| Yu et al., 2022 | 418.1 | 179.2 | 179.2 | 814.8 | 1.35 | 0 | 0 | 0 | 808.6 | 0.52 | 0 | 0 | 0 | 1.4 | 40.76 | 3.35 |
| 388.3 | 166.4 | 221.9 | 814.8 | 1.35 | 0 | 0 | 0 | 808.6 | 0.52 | 0 | 0 | 0 | 0.7 | 33.75 | 2.87 |
| 362.4 | 155.3 | 258.8 | 814.8 | 1.35 | 0 | 0 | 0 | 808.6 | 0.52 | 0 | 0 | 0 | 0.4 | 29.26 | 2.43 |
| 339.7 | 145.6 | 291.2 | 814.8 | 1.35 | 0 | 0 | 0 | 808.6 | 0.52 | 0 | 0 | 0 | 0.0 | 24.84 | 2.26 |
| 418.1 | 179.2 | 179.2 | 814.8 | 1.35 | 0 | 0 | 0 | 404.3 | 0.52 | 370.5 | 0.5 | 2.98 | 1.4 | 33.22 | 2.58 |
| 388.3 | 166.4 | 221.9 | 814.8 | 1.35 | 0 | 0 | 0 | 404.3 | 0.52 | 370.5 | 0.5 | 2.98 | 0.7 | 31.16 | 2.51 |
| 362.4 | 155.3 | 258.8 | 814.8 | 1.35 | 0 | 0 | 0 | 404.3 | 0.52 | 370.5 | 0.5 | 2.98 | 0.4 | 28.04 | 2.29 |
| 339.7 | 145.6 | 291.2 | 814.8 | 1.35 | 0 | 0 | 0 | 404.3 | 0.52 | 370.5 | 0.5 | 2.98 | 0.0 | 22.32 | 1.90 |
| 388.3 | 166.4 | 221.9 | 814.8 | 1.35 | 0 | 0 | 0 | 566 | 0.52 | 222.3 | 0.3 | 2.98 | 0.7 | 33.37 | 2.89 |
| 388.3 | 166.4 | 221.9 | 814.8 | 1.35 | 0 | 0 | 0 | 242.6 | 0.52 | 518.7 | 0.7 | 2.98 | 0.7 | 28.72 | 2.31 |
| 388.3 | 166.4 | 221.9 | 814.8 | 1.35 | 0 | 0 | 0 | 0 | 0.52 | 741 | 1.0 | 2.98 | 0.7 | 27.66 | 2.20 |
| 554.7 | 0.0 | 221.9 | 814.8 | 1.35 | 0 | 0 | 0 | 404.3 | 0.52 | 370.5 | 0.5 | 2.98 | 0.7 | 36.80 | 3.30 |
| 471.5 | 83.2 | 221.9 | 814.8 | 1.35 | 0 | 0 | 0 | 404.3 | 0.52 | 370.5 | 0.5 | 2.98 | 0.7 | 35.43 | 3.03 |
| 305.1 | 249.6 | 221.9 | 814.8 | 1.35 | 0 | 0 | 0 | 404.3 | 0.52 | 370.5 | 0.5 | 2.98 | 0.7 | 24.91 | 2.23 |
| 221.9 | 332.8 | 221.9 | 814.8 | 1.35 | 0 | 0 | 0 | 404.3 | 0.52 | 370.5 | 0.5 | 2.98 | 0.7 | 17.52 | 1.60 |
| 221.9 | 332.8 | 221.9 | 814.8 | 1.35 | 0 | 0 | 0 | 404.3 | 0.52 | 370.5 | 0.5 | 2.98 | 0.7 | 31.16 | 2.51 |
| Liao 2023 | 500.7 | 88.3 | 188.5 | 814.8 | 0.83 | 0 | 0 | 0 | 404.3 | 0.67 | 387.1 | 0.5 | 3.55 | 1.2 | 45.41 | 4.15 |
| 468.6 | 82.7 | 226.0 | 814.8 | 0.83 | 0 | 0 | 0 | 404.3 | 0.67 | 387.1 | 0.5 | 3.55 | 1.0 | 35.81 | 3.45 |
| 440.2 | 77.7 | 258.9 | 814.8 | 0.83 | 0 | 0 | 0 | 404.3 | 0.67 | 387.1 | 0.5 | 3.55 | 0.9 | 28.95 | 3.38 |
| 412.5 | 72.8 | 291.2 | 814.8 | 0.83 | 0 | 0 | 0 | 404.3 | 0.67 | 387.1 | 0.5 | 3.55 | 0.0 | 26.44 | 3.26 |
| 500.7 | 88.3 | 188.5 | 814.8 | 0.83 | 0 | 0 | 0 | 808.6 | 0.67 | 0 | 0 | 0 | 1.2 | 48.08 | 4.89 |
| 468.6 | 82.7 | 226.0 | 814.8 | 0.83 | 0 | 0 | 0 | 808.6 | 0.67 | 0 | 0 | 0 | 1.0 | 39.31 | 4.05 |
| 440.2 | 77.7 | 258.9 | 814.8 | 0.83 | 0 | 0 | 0 | 808.6 | 0.67 | 0 | 0 | 0 | 0.9 | 31.01 | 3.89 |
| 412.5 | 72.8 | 291.2 | 814.8 | 0.83 | 0 | 0 | 0 | 808.6 | 0.67 | 0 | 0 | 0 | 0.0 | 28.04 | 3.58 |
| 468.6 | 82.7 | 226.0 | 814.8 | 0.83 | 0 | 0 | 0 | 566 | 0.67 | 232.3 | 0.3 | 3.55 | 1.0 | 37.87 | 3.74 |
| 468.6 | 82.7 | 226.0 | 814.8 | 0.83 | 0 | 0 | 0 | 242.6 | 0.67 | 541.9 | 0.7 | 3.55 | 1.0 | 34.06 | 3.41 |
| 468.6 | 82.7 | 226.0 | 814.8 | 0.83 | 0 | 0 | 0 | 0 | 0.67 | 774.2 | 1 | 3.55 | 1.0 | 33.30 | 3.25 |
| 500.7 | 88.3 | 188.5 | 814.8 | 0.83 | 0 | 0 | 0 | 404.3 | 0.42 | 387.1 | 0.5 | 3.55 | 1.2 | 42.82 | 3.27 |
| 500.7 | 88.3 | 188.5 | 814.8 | 0.83 | 0 | 0 | 0 | 808.6 | 0.42 | 0 | 0 | 0 | 1.2 | 47.39 | 3.70 |
| 468.6 | 82.7 | 226.0 | 814.8 | 0.83 | 0 | 0 | 0 | 404.3 | 0.42 | 387.1 | 0.5 | 3.55 | 1.0 | 34.44 | 2.87 |
| 468.6 | 82.7 | 226.0 | 814.8 | 0.83 | 0 | 0 | 0 | 808.6 | 0.42 | 0 | 0 | 0 | 1.0 | 37.94 | 3.10 |
| 500.7 | 88.3 | 188.5 | 814.8 | 0.83 | 0 | 0 | 0 | 404.3 | 0.42 | 387.1 | 0.5 | 3.55 | 1.2 | 42.82 | 3.27 |
| 468.6 | 82.7 | 226.0 | 814.8 | 0.83 | 0 | 0 | 0 | 404.3 | 0.42 | 387.1 | 0.5 | 3.55 | 1.0 | 34.44 | 2.87 |
| 440.2 | 77.7 | 258.9 | 814.8 | 0.83 | 0 | 0 | 0 | 404.3 | 0.42 | 387.1 | 0.5 | 3.55 | 0.9 | 29.26 | 2.63 |
| 425.8 | 75.1 | 275.5 | 814.8 | 0.83 | 0 | 0 | 0 | 404.3 | 0.42 | 387.1 | 0.5 | 3.55 | 0.3 | 27.20 | 2.36 |
| 468.6 | 82.7 | 226.0 | 814.8 | 0.83 | 0 | 0 | 0 | 242.6 | 0.42 | 541.9 | 0.7 | 3.55 | 1.0 | 32.69 | 2.56 |
| 468.6 | 82.7 | 226.0 | 814.8 | 0.83 | 0 | 0 | 0 | 0 | 0.42 | 774.2 | 1 | 3.55 | 1.0 | 30.55 | 2.20 |
| Kou, 2021 | 353.1 | 111.6 | 223.1 | 832.6 | 1.75 | 0 | 0 | 0 | 866.6 | 1.02 | 0 | 0 | 0 | 0.6 | 39.00 |  |
| 353.1 | 111.6 | 223.1 | 832.6 | 1.75 | 0 | 0 | 0 | 0 | 1.02 | 743.8 | 1 | 7.28 | 0.6 | 28.90 |  |
| 353.1 | 111.6 | 223.1 | 832.6 | 1.75 | 0 | 0 | 0 | 433.2 | 1.02 | 371.9 | 0.5 | 5.56 | 0.6 | 30.60 |  |
| 353.1 | 111.6 | 223.1 | 832.6 | 1.75 | 0 | 0 | 0 | 0 | 1.02 | 775.2 | 1 | 4.48 | 0.6 | 31.00 |  |
| 353.1 | 111.6 | 223.1 | 832.6 | 1.75 | 0 | 0 | 0 | 0 | 1.02 | 805.9 | 1 | 5.56 | 0.6 | 36.50 |  |
| 353.1 | 111.6 | 223.1 | 0 | 1.75 | 713.1 | 1 | 11.74 | 0 | 1.02 | 775.2 | 1 | 5.56 | 0.6 | 26.90 |  |
| 353.1 | 111.6 | 223.1 | 416.2 | 1.75 | 356.6 | 0.5 | 11.74 | 0 | 1.02 | 775.2 | 1 | 5.56 | 0.6 | 27.40 |  |
| 353.1 | 111.6 | 223.1 | 0 | 1.75 | 778 | 1 | 9.54 | 0 | 1.02 | 775.2 | 1 | 5.56 | 0.6 | 27.10 |  |
| 353.1 | 111.6 | 223.1 | 0 | 1.75 | 804.5 | 1 | 8.75 | 0 | 1.02 | 775.2 | 1 | 5.56 | 0.6 | 29.10 |  |
| 353.1 | 111.6 | 130.1 | 832.6 | 1.75 | 0 | 0 | 0 | 866.6 | 1.02 | 0 | 0 | 0 | 0.6 | 56.30 |  |
| 353.1 | 111.6 | 130.1 | 832.6 | 1.75 | 0 | 0 | 0 | 0 | 1.02 | 743.8 | 1 | 7.28 | 0.6 | 47.10 |  |
| 353.1 | 111.6 | 130.1 | 832.6 | 1.75 | 0 | 0 | 0 | 433.2 | 1.02 | 371.9 | 0.5 | 5.56 | 0.6 | 51.00 |  |
| 353.1 | 111.6 | 130.1 | 832.6 | 1.75 | 0 | 0 | 0 | 0 | 1.02 | 775.2 | 1 | 4.48 | 0.6 | 52.40 |  |
| 353.1 | 111.6 | 130.1 | 832.6 | 1.75 | 0 | 0 | 0 | 0 | 1.02 | 805.9 | 1 | 5.56 | 0.6 | 55.00 |  |
| 353.1 | 111.6 | 130.1 | 0 | 1.75 | 713.1 | 1 | 11.74 | 0 | 1.02 | 775.2 | 1 | 5.56 | 0.6 | 44.70 |  |
| 353.1 | 111.6 | 130.1 | 416.2 | 1.75 | 356.6 | 0.5 | 11.74 | 0 | 1.02 | 775.2 | 1 | 5.56 | 0.6 | 47.10 |  |
| 353.1 | 111.6 | 130.1 | 0 | 1.75 | 778 | 1 | 9.54 | 0 | 1.02 | 775.2 | 1 | 5.56 | 0.6 | 46.80 |  |
| 353.1 | 111.6 | 130.1 | 0 | 1.75 | 804.5 | 1 | 8.75 | 0 | 1.02 | 775.2 | 1 | 5.56 | 0.6 | 49.50 |  |
| 353.1 | 111.6 | 176.6 | 832.6 | 1.75 | 0 | 0 | 0 | 866.8 | 1.02 | 0 | 0 | 0 | 0.6 | 50.08 |  |
| 353.1 | 111.6 | 176.6 | 832.6 | 1.75 | 0 | 0 | 0 | 649.9 | 1.02 | 193.8 | 0.25 | 5.56 | 0.6 | 47.44 |  |
| 353.1 | 111.6 | 176.6 | 832.6 | 1.75 | 0 | 0 | 0 | 433.3 | 1.02 | 387.6 | 0.5 | 5.56 | 0.6 | 46.48 |  |
| 353.1 | 111.6 | 176.6 | 832.6 | 1.75 | 0 | 0 | 0 | 0 | 1.02 | 775.2 | 1 | 5.56 | 0.6 | 44.96 |  |
| 353.1 | 111.6 | 176.6 | 832.6 | 1.75 | 0 | 0 | 0 | 0 | 1.02 | 743.8 | 1 | 7.28 | 0.6 | 37.76 |  |
| 353.1 | 111.6 | 176.6 | 832.6 | 1.75 | 0 | 0 | 0 | 0 | 1.02 | 805.9 | 1 | 4.48 | 0.6 | 48.56 |  |
| 353.1 | 111.6 | 176.6 | 832.6 | 1.75 | 0 | 0 | 0 | 0 | 1.02 | 743.8 | 1 | 7.28 | 0.6 | 30.64 |  |
| 353.1 | 111.6 | 176.6 | 832.6 | 1.75 | 0 | 0 | 0 | 0 | 1.02 | 743.8 | 1 | 7.28 | 0.6 | 49.20 |  |
| 353.1 | 111.6 | 176.6 | 416.3 | 1.75 | 402.2 | 0.5 | 8.75 | 0 | 1.02 | 805.9 | 1 | 4.48 | 0.6 | 44.72 |  |
| 353.1 | 111.6 | 176.6 | 0 | 1.75 | 804.5 | 1 | 8.75 | 0 | 1.02 | 805.9 | 1 | 4.48 | 0.6 | 39.84 |  |
| 353.1 | 111.6 | 176.6 | 832.6 | 1.75 | 0 | 0 | 0 | 866.6 | 1.02 | 0 | 0 | 0 | 0.6 | 44.20 |  |
| 353.1 | 111.6 | 176.6 | 832.6 | 1.75 | 0 | 0 | 0 | 0 | 1.02 | 805.9 | 1 | 4.48 | 0.6 | 43.00 |  |
| 353.1 | 111.6 | 176.6 | 832.6 | 1.75 | 0 | 0 | 0 | 0 | 1.02 | 775.2 | 1 | 5.56 | 0.6 | 37.20 |  |
| 353.1 | 111.6 | 176.6 | 832.6 | 1.75 | 0 | 0 | 0 | 0 | 1.02 | 743.8 | 1 | 7.28 | 0.6 | 33.70 |  |
| 353.1 | 111.6 | 176.6 | 832.6 | 1.75 | 0 | 0 | 0 | 433.2 | 1.02 | 387.6 | 0.5 | 5.56 | 0.6 | 40.90 |  |
| 353.1 | 111.6 | 176.6 | 416.2 | 1.75 | 402.2 | 0.5 | 8.75 | 866.6 | 1.02 | 0 | 0 | 0 | 0.6 | 39.90 |  |
| 353.1 | 111.6 | 176.6 | 0 | 1.75 | 402.2 | 1 | 8.75 | 866.6 | 1.02 | 0 | 0 | 0 | 0.6 | 37.70 |  |
| 353.1 | 111.6 | 176.6 | 416.2 | 1.75 | 402.2 | 0.5 | 8.75 | 0 | 1.02 | 775.2 | 1 | 5.56 | 0.6 | 34.10 |  |
| 353.1 | 111.6 | 176.6 | 416.2 | 1.75 | 402.2 | 0.5 | 8.75 | 0 | 1.02 | 775.2 | 1 | 5.56 | 0.6 | 38.10 |  |
| 353.1 | 111.6 | 176.6 | 0 | 1.75 | 402.2 | 1 | 8.75 | 0 | 1.02 | 775.2 | 1 | 5.56 | 0.6 | 35.50 |  |
| Barroqueiro et al., 2020 | 493.0 | 145.0 | 193.0 | 646 | 0.9 | 0 | 0 | 0 | 787 | 1.2 | 0 | 0 | 0 | 8.0 | 65.52 |  |
| 493.0 | 145.0 | 193.0 | 485 | 0.9 | 145 | 0.25 | 7.5 | 591 | 1.2 | 184 | 0.25 | 7.5 | 8.0 | 64.56 |  |
| 493.0 | 145.0 | 193.0 | 323 | 0.9 | 290 | 0.5 | 7.5 | 394 | 1.2 | 369 | 0.5 | 7.5 | 8.0 | 63.60 |  |
| 493.0 | 145.0 | 193.0 | 0 | 0.9 | 581 | 1 | 7.5 | 0 | 1.2 | 737 | 0.75 | 7.5 | 8.0 | 60.00 |  |
| 493.0 | 145.0 | 193.0 | 646 | 0.9 | 0 | 0 | 0 | 0 | 1.2 | 737 | 1 | 7.5 | 8.0 | 64.24 |  |
| 493.0 | 145.0 | 193.0 | 0 | 0.9 | 581 | 1 | 7.5 | 787 | 1.2 | 0 | 0 | 0 | 8.0 | 62.40 |  |
| Pedro et al., 2017a | 350.0 | 0.0 | 150.5 | 859 | 0.2 | 0 | 0 | 0 | 1027 | 1.3 | 0 | 0 | 0 | 3.5 | 58.08 | 4.56 |
| 350.0 | 0.0 | 150.5 | 644 | 0.2 | 209 | 0.25 | 6.1 | 770 | 1.3 | 236 | 0.25 | 3.9 | 3.5 | 54.56 | 3.88 |
| 350.0 | 0.0 | 154.0 | 641 | 0.2 | 206 | 0.25 | 6.1 | 766 | 1.3 | 245 | 0.25 | 3.9 | 3.5 | 55.12 | 3.71 |
| 350.0 | 0.0 | 154.0 | 427 | 0.2 | 416 | 0.5 | 6.1 | 511 | 1.3 | 469 | 0.5 | 3.9 | 3.5 | 53.20 | 3.62 |
| 350.0 | 0.0 | 154.0 | 427 | 0.2 | 413 | 0.5 | 6.1 | 511 | 1.3 | 490 | 0.5 | 3.9 | 3.5 | 51.04 | 3.46 |
| 350.0 | 0.0 | 157.5 | 0 | 0.2 | 828 | 1 | 6.1 | 0 | 1.3 | 934 | 1 | 3.9 | 3.5 | 49.44 | 2.96 |
| 350.0 | 0.0 | 157.5 | 0 | 0.2 | 821 | 1 | 6.1 | 0 | 1.3 | 975 | 1 | 3.9 | 3.5 | 48.80 | 2.82 |
| 350.0 | 0.0 | 157.5 | 0 | 0.2 | 828 | 1 | 6.1 | 1017 | 1.3 | 0 | 0 | 0 | 3.5 | 52.32 | 3.27 |
| 350.0 | 0.0 | 157.5 | 0 | 0.2 | 821 | 1 | 6.1 | 1017 | 1.3 | 0 | 0 | 0 | 3.5 | 49.20 | 2.92 |
| 350.0 | 0.0 | 150.5 | 859 | 0.2 | 0 | 0 | 0 | 0 | 1.3 | 943 | 1 | 3.9 | 3.5 | 54.96 | 3.93 |
| 350.0 | 0.0 | 150.5 | 859 | 0.2 | 0 | 0 | 0 | 0 | 1.3 | 985 | 1 | 3.9 | 3.5 | 53.52 | 3.78 |
| Pedro et al., 2017b | 550.0 | 55.0 | 169.4 | 690 | 0.2 | 0 | 0 | 0 | 889 | 1.3 | 0 | 0 | 0 | 12.1 | 74.72 | 5.08 |
| 550.0 | 55.0 | 175.5 | 342 | 0.2 | 348 | 0.5 | 6.1 | 440 | 1.3 | 453 | 0.5 | 3.9 | 12.1 | 73.04 | 3.91 |
| 550.0 | 55.0 | 187.6 | 0 | 0.2 | 659 | 1 | 6.1 | 0 | 1.3 | 829 | 1 | 3.9 | 12.1 | 72.08 | 3.60 |
| 550.0 | 55.0 | 175.5 | 683 | 0.2 | 0 | 0 | 0 | 0 | 1.3 | 847 | 1 | 3.9 | 12.1 | 73.20 | 4.02 |
| Soares et al., 2014 | 350.0 | 0.0 | 182.0 | 792.9 | 0.44 | 0 | 0 | 0 | 1008.6 | 1.41 | 0 | 0 | 0 | 0.0 | 38.40 |  |
| 350.0 | 0.0 | 182.0 | 792.9 | 0.44 | 0 | 0 | 0 | 907.8 | 1.41 | 93.3 | 0.1 | 4.62 | 0.0 | 37.52 |  |
| 350.0 | 0.0 | 182.0 | 792.9 | 0.44 | 0 | 0 | 0 | 806.8 | 1.41 | 186.5 | 0.2 | 4.62 | 0.0 | 38.16 |  |
| 350.0 | 0.0 | 182.0 | 792.9 | 0.44 | 0 | 0 | 0 | 806.8 | 1.41 | 186.5 | 0.3 | 4.62 | 0.0 | 40.64 |  |
| 350.0 | 0.0 | 182.0 | 792.9 | 0.44 | 0 | 0 | 0 | 605.1 | 1.41 | 372.9 | 0.4 | 4.62 | 0.0 | 38.40 |  |
| 350.0 | 0.0 | 182.0 | 792.9 | 0.44 | 0 | 0 | 0 | 504.3 | 1.41 | 466.3 | 0.5 | 4.62 | 0.0 | 39.60 |  |
| 350.0 | 0.0 | 182.0 | 792.9 | 0.44 | 0 | 0 | 0 | 0 | 1.41 | 932.5 | 1 | 4.62 | 0.0 | 40.24 |  |
| 350.0 | 0.0 | 143.5 | 835.3 | 0.44 | 0 | 0 | 0 | 0 | 1.41 | 982.4 | 1 | 4.62 | 1.8 | 51.04 |  |
| 350.0 | 0.0 | 143.5 | 833.2 | 0.44 | 0 | 0 | 0 | 0 | 1.41 | 979.9 | 1 | 4.62 | 3.5 | 54.08 |  |
| 350.0 | 0.0 | 140.0 | 835.3 | 0.44 | 0 | 0 | 0 | 0 | 1.41 | 982.4 | 1 | 4.62 | 5.3 | 48.64 |  |
| 350.0 | 0.0 | 136.5 | 837.3 | 0.44 | 0 | 0 | 0 | 0 | 1.41 | 984.6 | 1 | 4.62 | 7.0 | 56.24 |  |
| Santos et al., 2019 | 329.0 | 247.0 | 187.0 | 698 | 0.4 | 0 | 0 | 0 | 787 | 1.2 | 0 | 0 | 0 | 3.0 | 34.32 |  |
| 329.0 | 247.0 | 187.0 | 523 | 0.4 | 167 | 0.25 | 5 | 591 | 1.2 | 193 | 0.25 | 1.8 | 3.0 | 31.12 |  |
| 329.0 | 247.0 | 187.0 | 349 | 0.4 | 333 | 0.5 | 5 | 394 | 1.2 | 385 | 0.5 | 1.8 | 3.0 | 29.60 |  |
| 329.0 | 247.0 | 187.0 | 698 | 0.4 | 0 | 0 | 0 | 0 | 1.2 | 770 | 1 | 1.8 | 3.0 | 27.20 |  |
| 329.0 | 247.0 | 187.0 | 0 | 0.4 | 667 | 1 | 5 | 787 | 1.2 | 0 | 0 | 0 | 3.0 | 23.28 |  |
| 466.0 | 148.0 | 188.0 | 695 | 0.4 | 0 | 0 | 0 | 787 | 1.2 | 0 | 0 | 0 | 4.0 | 62.96 |  |
| 466.0 | 148.0 | 188.0 | 521 | 0.4 | 156 | 0.25 | 7.5 | 591 | 1.2 | 184 | 0.25 | 2.2 | 4.0 | 62.08 |  |
| 466.0 | 148.0 | 188.0 | 347 | 0.4 | 312 | 0.5 | 7.5 | 394 | 1.2 | 369 | 0.5 | 2.2 | 4.0 | 60.48 |  |
| 466.0 | 148.0 | 188.0 | 695 | 0.4 | 0 | 0 | 0 | 0 | 1.2 | 737 | 1 | 2.2 | 4.0 | 59.36 |  |
| 466.0 | 148.0 | 188.0 | 0 | 0.4 | 624 | 1 | 7.5 | 787 | 1.2 | 0 | 0 | 0 | 4.0 | 55.44 |  |
| Venkrbec & Klansek, 2020 | 380.0 | 0.0 | 166.0 | 951.55 | 1.1 | 0 | 0 | 0 | 951.55 | 1.5 | 0 | 0 | 0 | 2.0 | 26.67 |  |
| 380.0 | 0.0 | 166.0 | 542.88 | 1.1 | 361.92 | 0.4 | 9.4 | 542.88 | 1.5 | 573.93 | 0.6 | 6.4 | 2.0 | 21.60 |  |
| 380.0 | 0.0 | 166.0 | 566.77 | 1.1 | 377.85 | 0.4 | 9.4 | 566.76 | 1.5 | 599.19 | 0.6 | 6.4 | 2.0 | 19.03 |  |
| Thomas et al., 2016 | 300.0 | 0.0 | 175.0 | 926 | 0.26 | 0 | 0 | 0 | 1002 | 1.16 | 0 | 0 | 0 | 1.4 | 36.50 | 1.40 |
| 300.0 | 0.0 | 175.0 | 900 | 0.26 | 0 | 0 | 0 | 800 | 1.16 | 280 | 0.2 | 4.37 | 1.5 | 36.70 | 1.65 |
| 300.0 | 0.0 | 175.0 | 900 | 0.26 | 0 | 0 | 0 | 500 | 1.16 | 560 | 0.5 | 4.37 | 2.0 | 37.70 | 1.86 |
| 300.0 | 0.0 | 175.0 | 800 | 0.26 | 0 | 0 | 0 | 0 | 1.16 | 1115 | 1 | 4.37 | 2.1 | 38.40 | 1.94 |
| This study | 448.6 | 149.5 | 179.4 | 814.8 | 0.83 | 0 | 0 | 0 | 404.3 | 0.67 | 387.1 | 0.5 | 3.55 | 1.2 | 41.73 | 4.02 |
| 448.6 | 149.5 | 179.4 | 611.1 | 0.83 | 169.05 | 0.25 | 8.17 | 404.3 | 0.67 | 387.1 | 0.5 | 3.55 | 1.6 | 40.07 | 3.78 |
| 448.6 | 149.5 | 179.4 | 407.4 | 0.83 | 338.14 | 0.5 | 8.17 | 404.3 | 0.67 | 387.1 | 0.5 | 3.55 | 1.7 | 36.49 | 3.22 |
| 448.6 | 149.5 | 179.4 | 203.7 | 0.83 | 507.15 | 0.75 | 8.17 | 404.3 | 0.67 | 387.1 | 0.5 | 3.55 | 2.0 | 32.15 | 2.90 |
| 448.6 | 149.5 | 179.4 | 0 | 0.83 | 676.2 | 1 | 8.17 | 404.3 | 0.67 | 387.1 | 0.5 | 3.55 | 2.5 | 29.85 | 2.65 |
| 425.6 | 141.9 | 210.0 | 814.8 | 0.83 | 0 | 0 | 0 | 404.3 | 0.67 | 387.1 | 0.5 | 3.55 | 0.8 | 36.63 | 3.48 |
| 425.6 | 141.9 | 210.0 | 611.1 | 0.83 | 169.05 | 0.25 | 8.17 | 404.3 | 0.67 | 387.1 | 0.5 | 3.55 | 1.0 | 36.37 | 3.28 |
| 425.6 | 141.9 | 210.0 | 407.4 | 0.83 | 338.14 | 0.5 | 8.17 | 404.3 | 0.67 | 387.1 | 0.5 | 3.55 | 1.1 | 30.97 | 2.85 |
| 425.6 | 141.9 | 210.0 | 203.7 | 0.83 | 507.15 | 0.75 | 8.17 | 404.3 | 0.67 | 387.1 | 0.5 | 3.55 | 1.5 | 29.84 | 2.61 |
| 425.6 | 141.9 | 210.0 | 0 | 0.83 | 676.2 | 1 | 8.17 | 404.3 | 0.67 | 387.1 | 0.5 | 3.55 | 1.8 | 26.71 | 2.47 |
| 401.9 | 134.0 | 241.1 | 814.8 | 0.83 | 0 | 0 | 0 | 404.3 | 0.67 | 387.1 | 0.5 | 3.55 | 0.6 | 31.76 | 3.01 |
| 401.9 | 134.0 | 241.1 | 611.1 | 0.83 | 169.05 | 0.25 | 8.17 | 404.3 | 0.67 | 387.1 | 0.5 | 3.55 | 0.8 | 31.60 | 2.82 |
| 401.9 | 134.0 | 241.1 | 407.4 | 0.83 | 338.14 | 0.5 | 8.17 | 404.3 | 0.67 | 387.1 | 0.5 | 3.55 | 1.1 | 29.28 | 2.62 |
| 401.9 | 134.0 | 241.1 | 203.7 | 0.83 | 507.15 | 0.75 | 8.17 | 404.3 | 0.67 | 387.1 | 0.5 | 3.55 | 1.5 | 27.68 | 2.42 |
| 401.9 | 134.0 | 241.1 | 0 | 0.83 | 676.2 | 1 | 8.17 | 404.3 | 0.67 | 387.1 | 0.5 | 3.55 | 1.7 | 24.30 | 2.24 |
| 383.6 | 127.9 | 266.0 | 814.8 | 0.83 | 0 | 0 | 0 | 404.3 | 0.67 | 387.1 | 0.5 | 3.55 | 0.2 | 27.58 | 2.80 |
| 383.6 | 127.9 | 266.0 | 611.1 | 0.83 | 169.05 | 0.25 | 8.17 | 404.3 | 0.67 | 387.1 | 0.5 | 3.55 | 0.2 | 27.14 | 2.71 |
| 383.6 | 127.9 | 266.0 | 407.4 | 0.83 | 338.14 | 0.5 | 8.17 | 404.3 | 0.67 | 387.1 | 0.5 | 3.55 | 0.4 | 25.67 | 2.53 |
| 383.6 | 127.9 | 266.0 | 203.7 | 0.83 | 507.15 | 0.75 | 8.17 | 404.3 | 0.67 | 387.1 | 0.5 | 3.55 | 0.8 | 23.25 | 2.37 |
| 383.6 | 127.9 | 266.0 | 0 | 0.83 | 676.2 | 1 | 8.17 | 404.3 | 0.67 | 387.1 | 0.5 | 3.55 | 0.9 | 21.86 | 2.18 |
| 364.0 | 121.3 | 291.2 | 814.8 | 0.83 | 0 | 0 | 0 | 404.3 | 0.67 | 387.1 | 0.5 | 3.55 | 0.0 | 23.08 | 2.78 |
| 364.0 | 121.3 | 291.2 | 611.1 | 0.83 | 169.05 | 0.25 | 8.17 | 404.3 | 0.67 | 387.1 | 0.5 | 3.55 | 0.0 | 23.55 | 2.78 |
| 364.0 | 121.3 | 291.2 | 407.4 | 0.83 | 338.14 | 0.5 | 8.17 | 404.3 | 0.67 | 387.1 | 0.5 | 3.55 | 0.0 | 22.74 | 2.33 |
| 364.0 | 121.3 | 291.2 | 203.7 | 0.83 | 507.15 | 0.75 | 8.17 | 404.3 | 0.67 | 387.1 | 0.5 | 3.55 | 0.5 | 21.40 | 2.25 |
| 364.0 | 121.3 | 291.2 | 0 | 0.83 | 676.2 | 1 | 8.17 | 404.3 | 0.67 | 387.1 | 0.5 | 3.55 | 0.7 | 18.60 | 2.15 |
| 353.4 | 117.8 | 306.3 | 814.8 | 0.83 | 0 | 0 | 0 | 404.3 | 0.67 | 387.1 | 0.5 | 3.55 | 0.0 | 19.23 | 2.29 |
| 353.4 | 117.8 | 306.3 | 611.1 | 0.83 | 169.05 | 0.25 | 8.17 | 404.3 | 0.67 | 387.1 | 0.5 | 3.55 | 0.0 | 19.40 | 2.25 |
| 353.4 | 117.8 | 306.3 | 407.4 | 0.83 | 338.14 | 0.5 | 8.17 | 404.3 | 0.67 | 387.1 | 0.5 | 3.55 | 0.0 | 18.53 | 2.18 |
| 353.4 | 117.8 | 306.3 | 203.7 | 0.83 | 507.15 | 0.75 | 8.17 | 404.3 | 0.67 | 387.1 | 0.5 | 3.55 | 0.0 | 17.10 | 2.05 |
| 353.4 | 117.8 | 306.3 | 0 | 0.83 | 676.2 | 1 | 8.17 | 404.3 | 0.67 | 387.1 | 0.5 | 3.55 | 0.0 | 16.53 | 1.84 |

**Appendix B Validation of Cuckoo Search Algorithm**

**Problem 1: ZDT1**



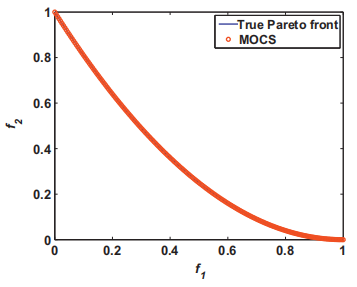
**Answer:**



**Problem 2: ZDT2**



**Answer:**



**Problem 3: LZ**



**Answer:**

