

Appendix VII

Base Case Values and Perturbations for Sensitivity Analysis

The following tables show the input parameters studied for the sensitivity analysis, their base case values and the number of perturbations performed. Tables A7.1, A7.2 and A7.3 give the data for building load, HVAC systems and HVAC refrigeration plant, respectively.

Table A7.1 Base Case Values and Perturbations for Building Load

| | Abbr. | Input parameter | Unit | Base case | Perturbations | | |
|---|-------|---------------------------------|---------------------|-----------|---------------|-------|-------|
| | | | | | Nos. | Min. | Max. |
| <i>Building Load —(a) Building Envelope</i> | | | | | | | |
| 1 | AR | Absorptance of roof | — | 0.7 | 6 | 0 | 1 |
| 2 | AW | Absorptance of wall | — | 0.7 | 6 | 0 | 1 |
| 3 | EG | Egg-crate shading | — | 0 | 15 | 0.2 | 3 |
| 4 | FN | Side-fins projection ratio | — | 0 | 15 | 0.2 | 3 |
| 5 | OV | Overhang projection ratio | — | 0 | 15 | 0.2 | 3 |
| 6 | SC | Shading coefficient of windows | — | 0.4 | 7 | 0 | 1 |
| 7 | SF | Skylight to roof ratio SRR | — | 0 | 6 | 0.2 | 1 |
| 8 | SS | Shading coefficient of skylight | — | N/A | 7 | 0 | 1 |
| 9 | UF | U-value of fenestration | W/m ² .K | 5.6 | 9 | 1 | 9 |
| 10 | UI | U-value of interior partitions | W/m ² .K | 2.513 | 3 | 0.49 | 3.149 |
| 11 | UR | U-value of roof | W/m ² .K | 0.539 | 4 | 0.426 | 2.147 |
| 12 | US | U-value of skylight | W/m ² .K | N/A | 9 | 1 | 9 |
| 13 | UW | U-value of opaque wall | W/m ² .K | 2.005 | 5 | 0.513 | 4.208 |
| 14 | WR | Window-to-wall ratio WWR | — | 0.44 | 6 | 0.1 | 1 |
| <i>Building Load —(b) Building Configuration</i> | | | | | | | |
| 15 | AS | Aspect ratio of plan | — | 1.0 | 9 | 0.5 | 5 |
| 16 | FH | Floor-to-floor height | m | 3.4 | 6 | 2.5 | 5 |
| 17 | NS | Number of storeys | Nos. | 40 | 4 | 10 | 50 |
| 18 | OR | Orientation | Degree | N,E,S,W | 9 | 5 | 45 |
| 19 | PZ | Perimeter zone depth | m | 4.57 | 15 | 1 | 8 |
| <i>Building Load —(c) Space Load & Space Conditions</i> | | | | | | | |
| 20 | AT | Space air temperature | °C | 25.5 | 9 | 21 | 29 |
| 21 | EQ | Equipment load | W/m ² | 15 | 6 | 0 | 30 |
| 22 | IF | Infiltration rate | ACH | 0.6 | 10 | 0 | 2 |
| 23 | LL | Lighting load | W/m ² | 20 | 6 | 0 | 30 |
| 24 | LT | Lighting type | — | Rec-F-Nv | 3 | — | — |
| 25 | OC | Occupant density | psn/m ² | 0.2 | 6 | 0.1 | 1 |
| <i>Building Load —(d) Building Thermal Mass</i> | | | | | | | |
| 26 | FT | Furniture type (weight) | — | Heavy | 1 | — | — |
| 27 | FW | Floor weight | kg/m ³ | 342 | 10 | 50 | 700 |
| 28 | RW | Roof weight | kg/m ³ | 496.1 | 4 | 483.1 | 502.6 |
| 29 | WW | Wall weight | kg/m ³ | 25.2 | 5 | 195.3 | 794.9 |

Table A7.2 Base Case Values and Perturbations for HVAC Systems

| | Abbr. | Input parameter | Unit | Base case | Perturbations | | |
|--|-------|----------------------------------|---------|-------------|---------------|------|------|
| | | | | | Nos. | Min. | Max. |
| <i>HVAC System — (a) System Operation</i> | | | | | | | |
| 1 | AC | Type of air side system | — | VAV Reheat | 4 | — | — |
| 2 | EC | Economiser control | — | Yes | 4 | — | — |
| 3 | OA | Outdoor air flow rate | l/s/psn | 7 | 11 | 0 | 20 |
| 4 | OH | Operation hours | — | 10 hr/day | 3 | — | — |
| <i>HVAC System — (b) System Controls</i> | | | | | | | |
| 5 | OL | Outdoor air control | — | By temp. | 2 | — | — |
| 6 | QR | Minimum cfm ratio | — | 0.3 | 4 | 0.1 | 0.5 |
| 7 | RD | Reheat delta temperature | °C | 5 | 13 | 2 | 15 |
| 8 | SR | Supply air temperature reset | — | Yes | 3 | — | — |
| 9 | TR | Throttling range | °C | 1.1 | 14 | 0.06 | 3.33 |
| 10 | TS | Therm. setpoint (summer cooling) | °C | 25.5 | 17 | 21 | 29 |
| 11 | TT | Thermostat type | — | Rev. action | 2 | — | — |
| 12 | TW | Therm. setpoint (winter heating) | °C | 21 | 17 | 19 | 27 |
| <i>HVAC System — (c) Fans & Air Handling</i> | | | | | | | |
| 13 | FC | Fan control method | — | Inlet vane | 2 | — | — |
| 14 | FE | Fan efficiency | — | 0.55 | 5 | 0.1 | 0.9 |
| 15 | FM | Fan motor placement | — | In air flow | 1 | — | — |
| 16 | FP | Fan placement | — | Draw-thru | 1 | — | — |
| 17 | FS | System fan static pressure | Pa | 1369 | 6 | 500 | 3000 |

Table A7.3 Base Case Values and Perturbations for HVAC Refrigeration Plant

| | Abbr. | Input parameter | Unit | Base case | Perturbations | | |
|--|-------|---|--------------------|--------------|---------------|-------|------|
| | | | | | Nos. | Min. | Max. |
| <i>HVAC Refrigeration Plant — (a) Chilled Water Circuit</i> | | | | | | | |
| 1 | CH | Chw. supply temperature | °C | 6.7 | 11 | 4 | 9 |
| 2 | CR | Chw. throttling range | °C | 1.39 | 6 | 0.6 | 2.6 |
| 3 | DT | Chw. design delta temp. | °C | 5.56 | 11 | 3 | 8 |
| <i>HVAC Refrigeration Plant — (b) Chilled Water Pump</i> | | | | | | | |
| 4 | PE | Pump motor efficiency | — | 0.9 | 6 | 0.8 | 1 |
| 5 | PH | Pump head | m H ₂ O | 20 | 7 | 5 | 40 |
| 6 | PI | Pump impeller efficiency | — | 0.77 | 11 | 0.5 | 1 |
| 7 | PL | Fraction of pump loss | — | 0.01 | 6 | 0.001 | 0.02 |
| 8 | PS | Pump sizing option | — | System peak | 2 | — | — |
| 9 | PT | Pump speed control type | — | Fixed | 1 | — | — |
| <i>HVAC Refrigeration Plant — (c) Refrigeration & Heat Rejection</i> | | | | | | | |
| 10 | CP | Chiller COP (kW/TR) | — | 1.2 | 8 | 0.5 | 4 |
| 11 | HG | Max. PLR for hot gas bypass | — | 0.25 | 10 | 0.2 | 0.7 |
| 12 | HR | Heat rejection method | — | Air-cooled | 1 | — | — |
| 13 | MA | Min. entering air temperature | °C | 18.33 | 11 | 10 | 30 |
| 14 | NC | Number of identical chillers | Nos. | 6 | 9 | 1 | 10 |
| 15 | PC | Ratio of condenser fan electric power to chiller capacity | — | 0.03 | 5 | 0.02 | 0.1 |
| 16 | RF | Type of chiller compressor | — | Herm. recip. | 3 | — | — |