



Engineering a Sustainable
Built Environment

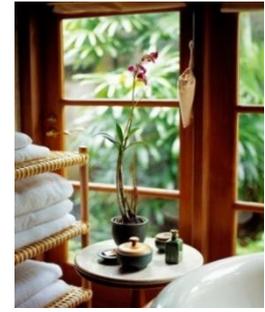
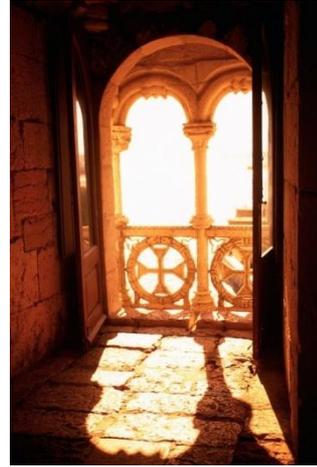
ADVANCES IN DAYLIGHT SIMULATION

*A joint event by the CIBSE Building Simulation Group and the
CIBSE Daylight Group*

Why is Daylight design the Cinderella of Building
Modelling

David Mooney Regional Associate PB

People like natural light



Are you wasting 10% of your electricity

Are your lights on during daylight hours?

Lights on Blinds Down= Bad Design

Presentation Content

1. Why daylight modelling is increasingly important
2. Project Constraints.
3. What Tools do we need for Daylight Modelling.
4. What and when Sunlight Modelling is Important.
5. Sunlight and Daylight Products.
6. Integrating Lighting Control Design with Daylight Modelling.
7. Case Studies.
8. Conclusions.

Why daylight modelling is increasingly important

Why is daylight modelling important

- Energy consumption.
- Statutory/regulatory change.
- Benchmarking.
- Quality of Internal environment
- User satisfaction and wellbeing

The Headlines

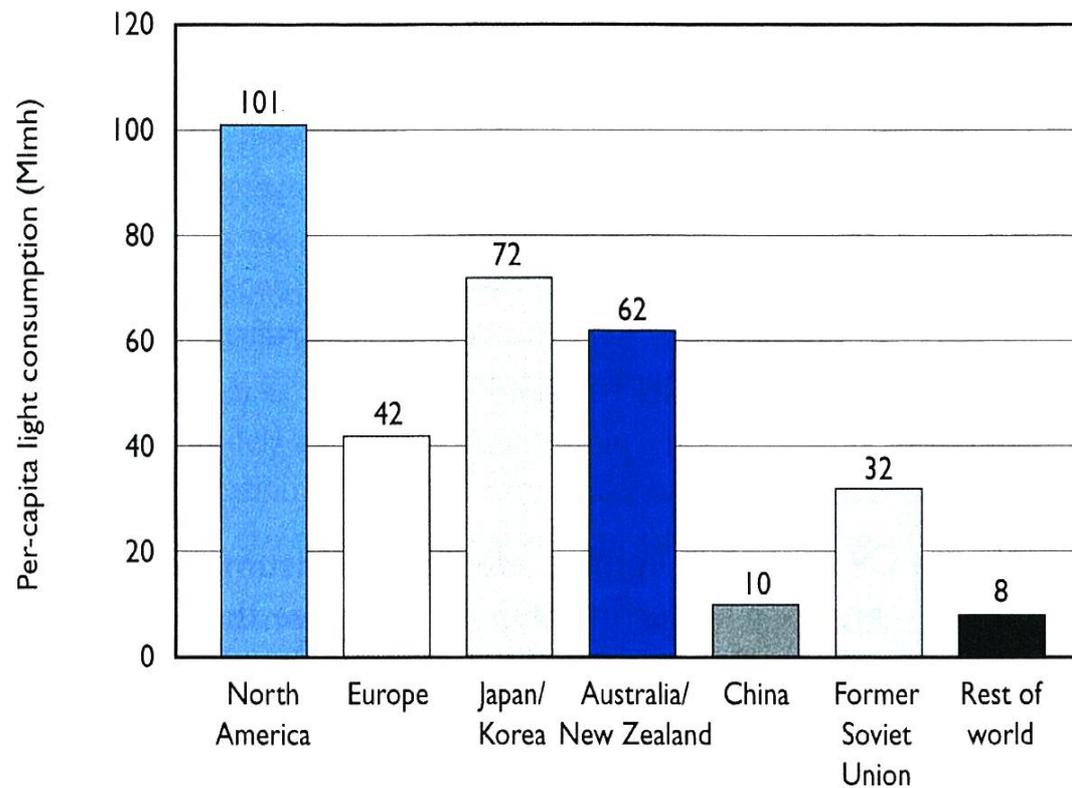
- Electric Lighting currently consumes 19% of current total global electricity
 - = 1.9 Gt of CO₂/yr.
- If current energy efficiency polices do not change will increase to
 - = 3 Gt of CO₂/yr by 2030

IEA/OECD Lights Labours Lost 2006

There is no viable alternative to electric lighting during darkness hours that meets current design standards.

Energy consumption 1

Figure OR.1 Estimated per-capita consumption of electric light* in 2005



* Source-lumens.

Abbreviation: Mlmh = megalumen-hours.

Regulations, Standards and Guides

Regulations

- European workplace directive - *Access to daylight required*
- Building Regulations - *No minimum daylight standards*

Standards

- BS 8206-2 2008 Code of Practice for daylighting.
- BREEAM 2008 (*four points only !!!!!*)
- Building Bulletin 87 Guidelines for environmental design in schools
- Lighting design for schools Building Bulletin 90
- Designing schools for the future Building Bulletin 95
- CIBSE LG2 Lighting for Healthcare buildings

Guides

- CIBSE SLL Daylighting and window design LG10 1999
- BRE Designing buildings for daylight.
- BRE Designing with innovative daylighting

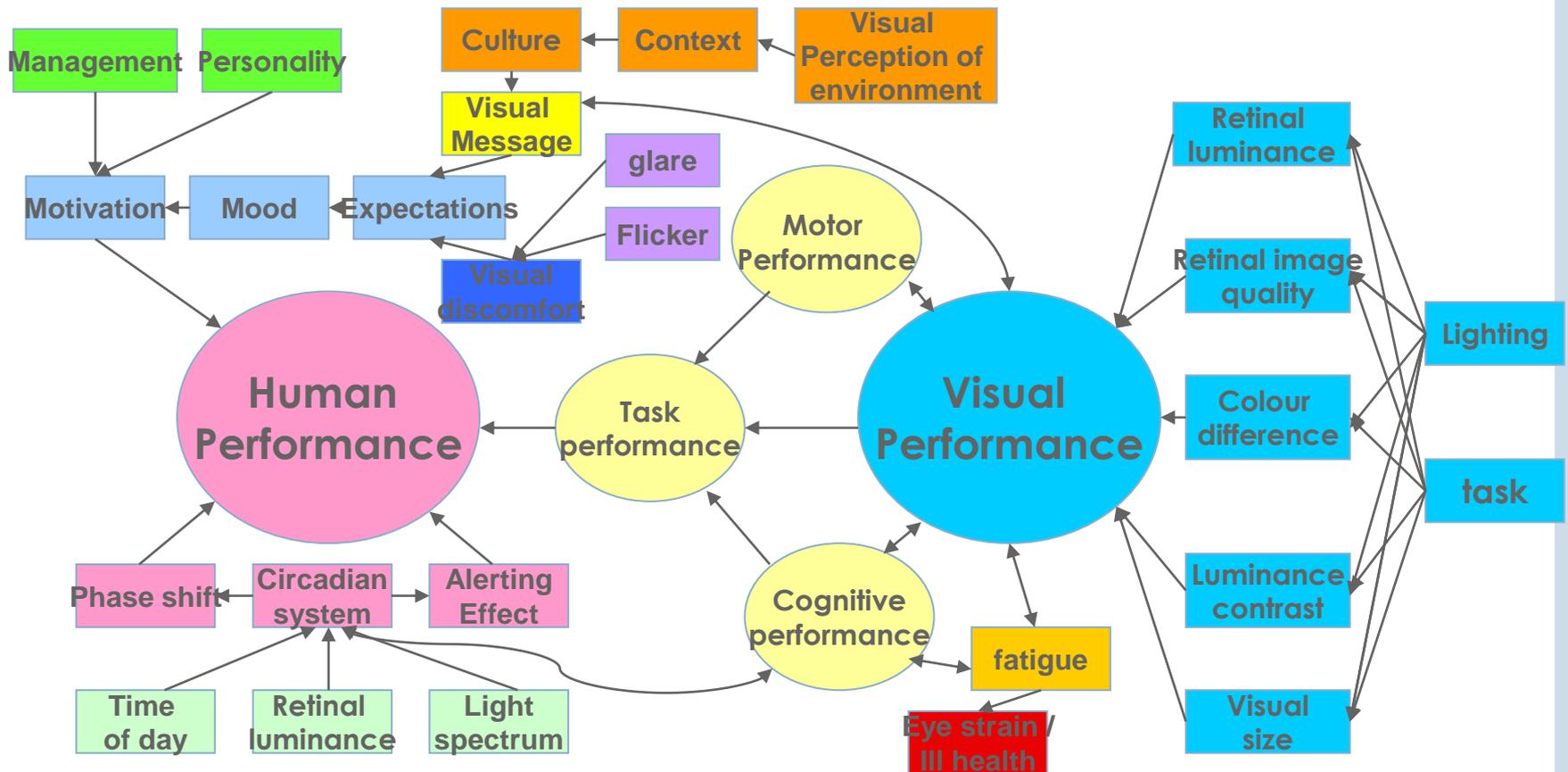
BREEAM 2008

- HEA 1 Daylighting 1pt= 2%av 1pt
Multi St 3%av Uo 0.4 single st 4%
av Uo 0.4
- HEA 6 Lighting zones and controls
1pt.
- HEA 2 View to outside 1pt
- HEA 3 Glare 1pt

LEED

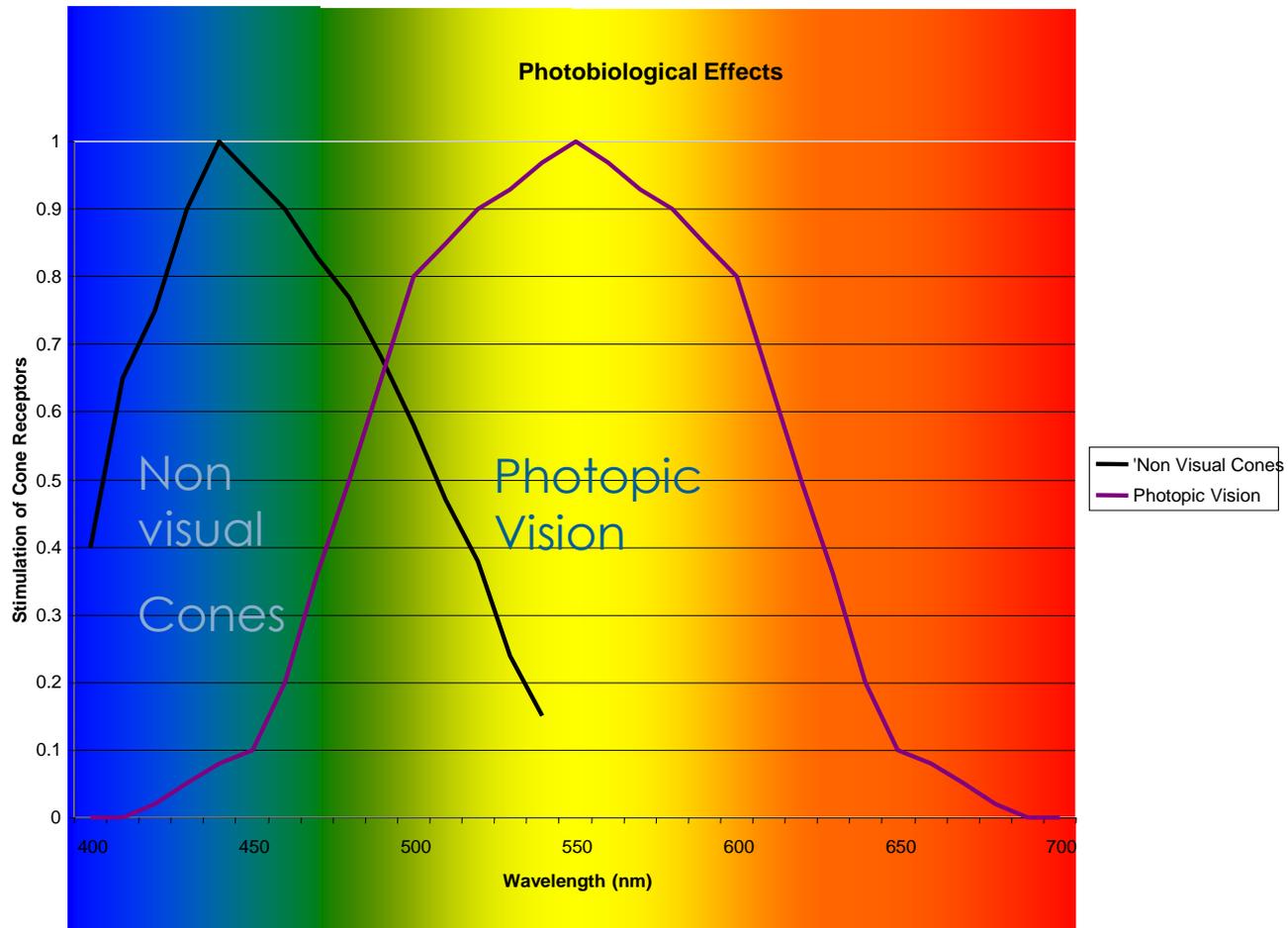
- Credit 8.1 Daylight and views—
Daylight, 1 point
- Credit 8.2 Daylight and views—
Views, 1 point

Wellbeing 1

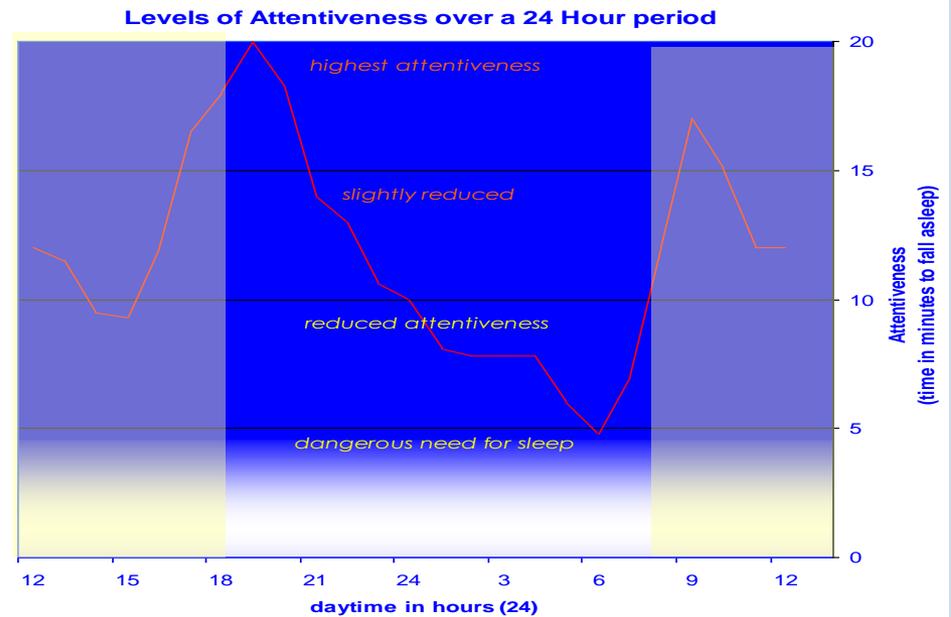
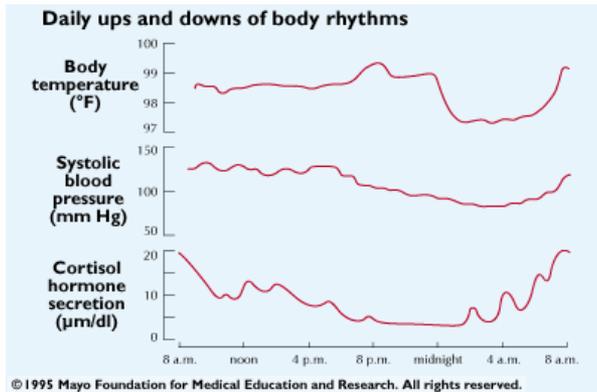


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Wellbeing 2



Wellbeing 3



Non visual
Cones

midday

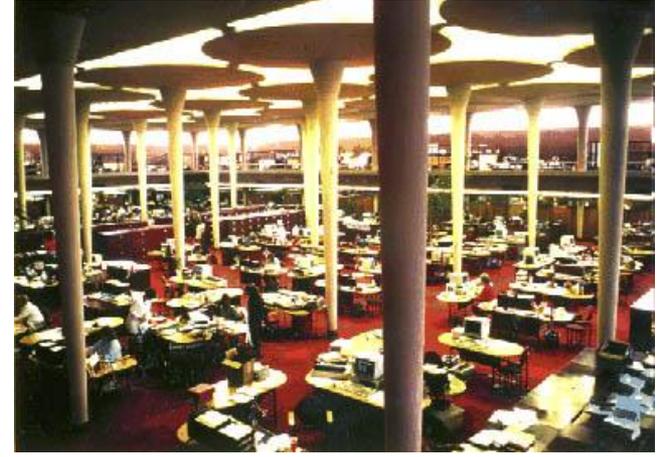
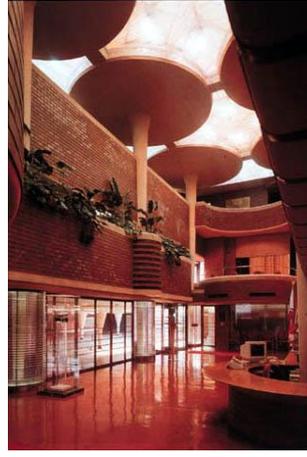
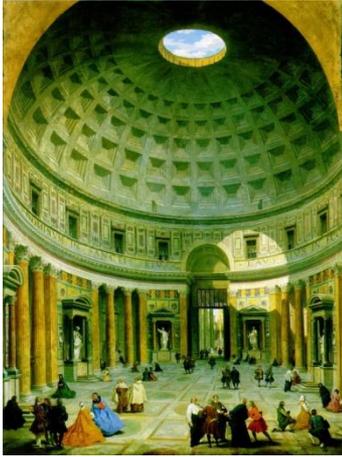
midday

Project Constraints.

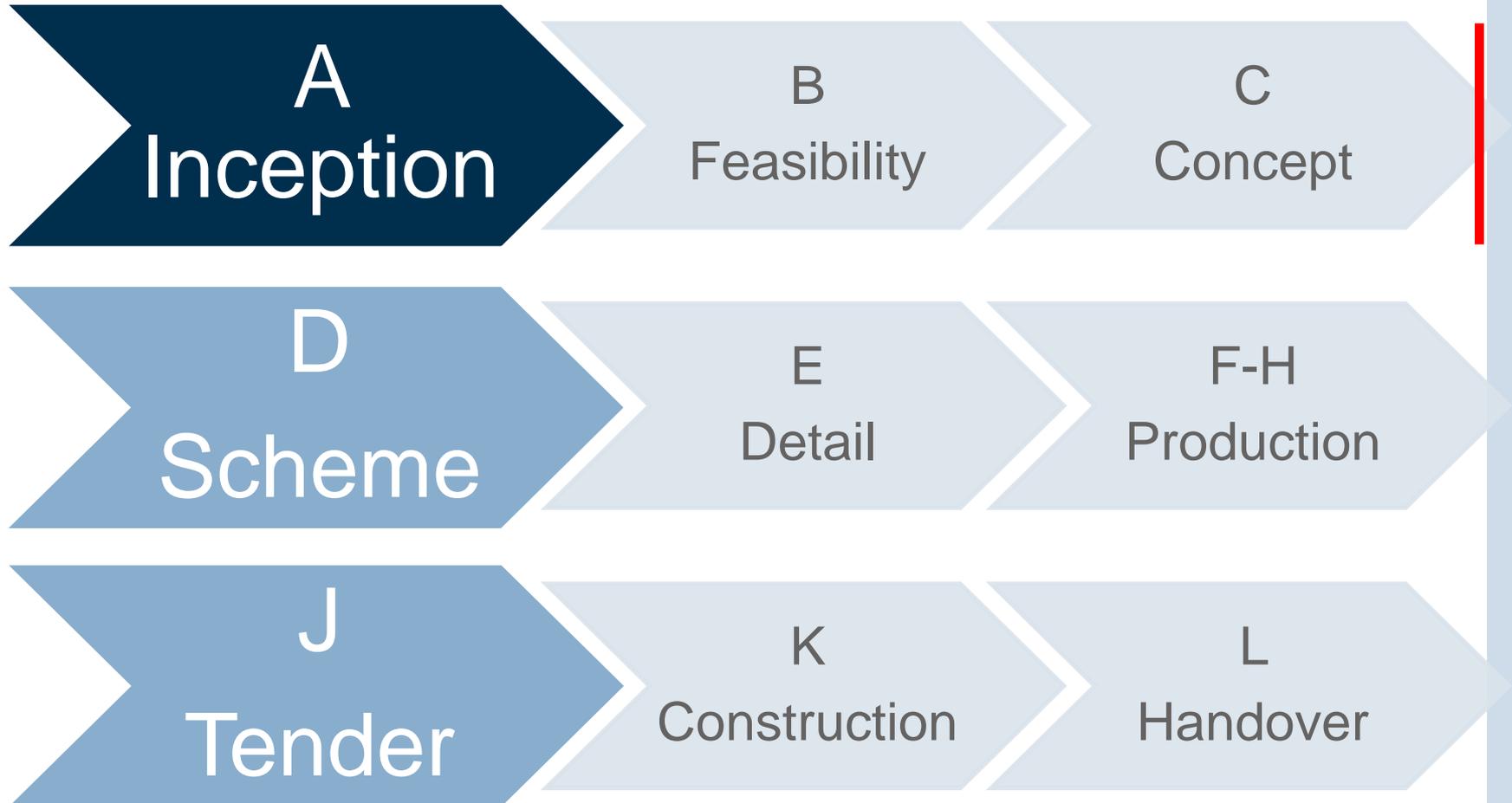
Who is responsible for daylight design

- Architect
- Electrical engineer
- Mechanical engineer
- Environmental Specialist
- Lighting Designer/Specialist
- Lighting Supplier

Daylit architecture



When does Daylight Design Happen



What Tools do we need for Daylight Modelling

Modelling Tools

- Physical Modelling
- Computer Modelling
- Manual Modelling

Physical Modelling

- Build a scale model of the building or section of the building.
- Use external daylight to simulate conditions
- Use Artificial skies

Computer Modelling

Hybrid post Ray Tracing and Radiosity packages

- Dialux
- Relux
- AGI 32
- Lumen Designer
- Revit
- 3D Studio Max

Backward Ray Tracing packages

- Radiance
- Superlite
- Adeline

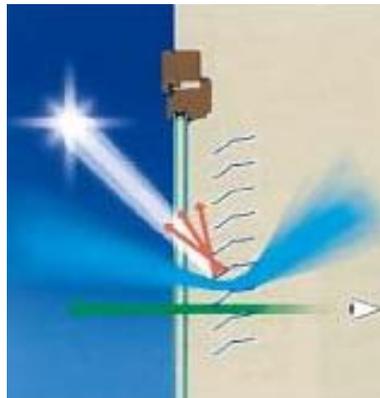
What and when Sunlight Modelling is Important.

Sunlight Modelling 1

- We need to consider shading.
- We need to look at sun patches and the dynamic quality of daylight in the space.

Sunlight and Daylight Products

Sunlight and daylight products 1



Sunlight and daylight products 2



Integrating Daylight with Electric Light

Lighting Integration 1

For successful daylight/electric lighting integration

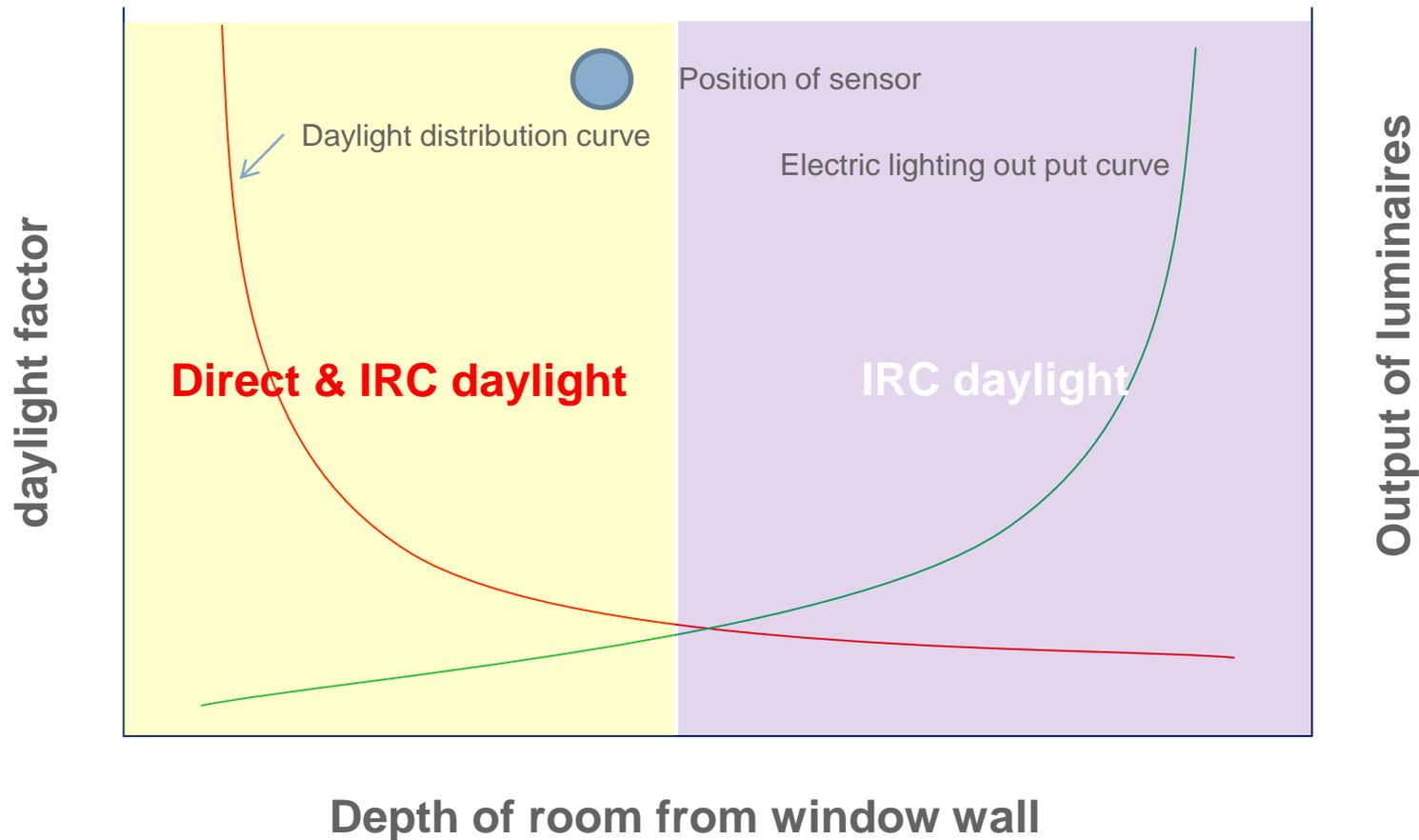
- Appropriate luminaire and lamp packages
- Appropriate control systems
- Understanding the client's expectations and needs
- Understanding the client's occupation patterns
- Correct commissioning of the systems
- Respecting the users.

Appropriate lamp and luminaire packages

- We need dimmable sources
- We need digital control gear technologies
- We need luminaires with appropriate optical distributions.
- We need luminaires that can still maintain their lit form through a range of luminances.

Typical daylight penetration diagram

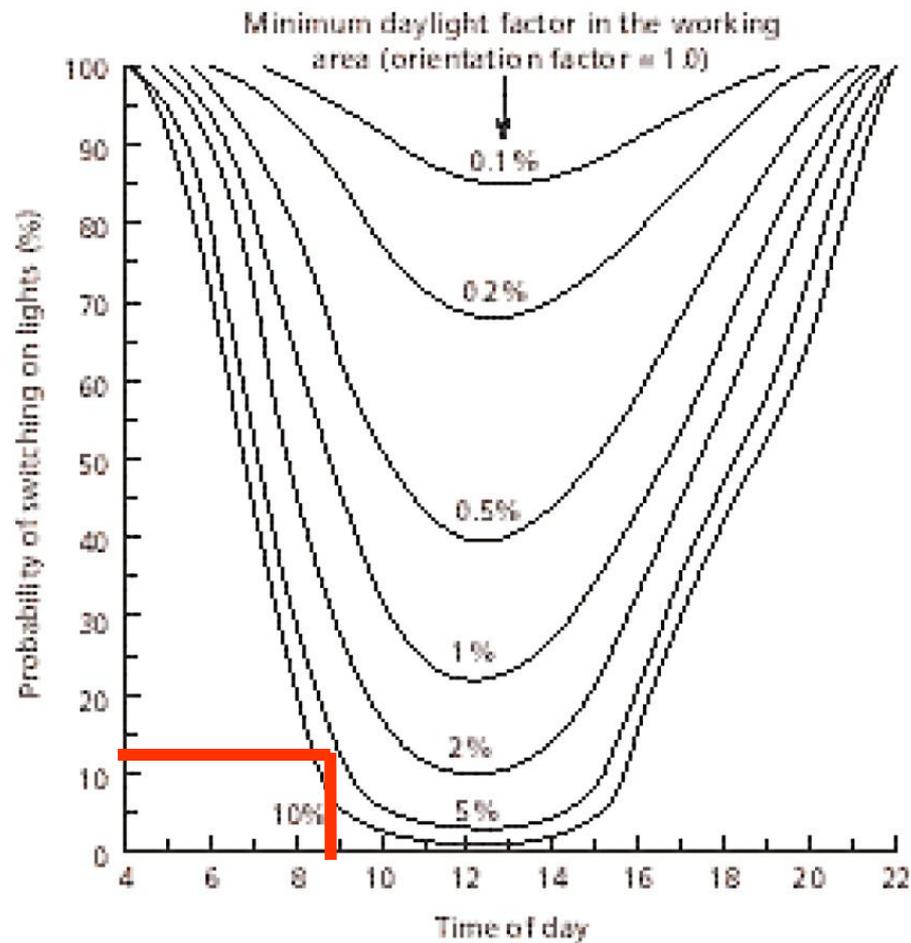
Single sided daylit room



Appropriate Control Systems

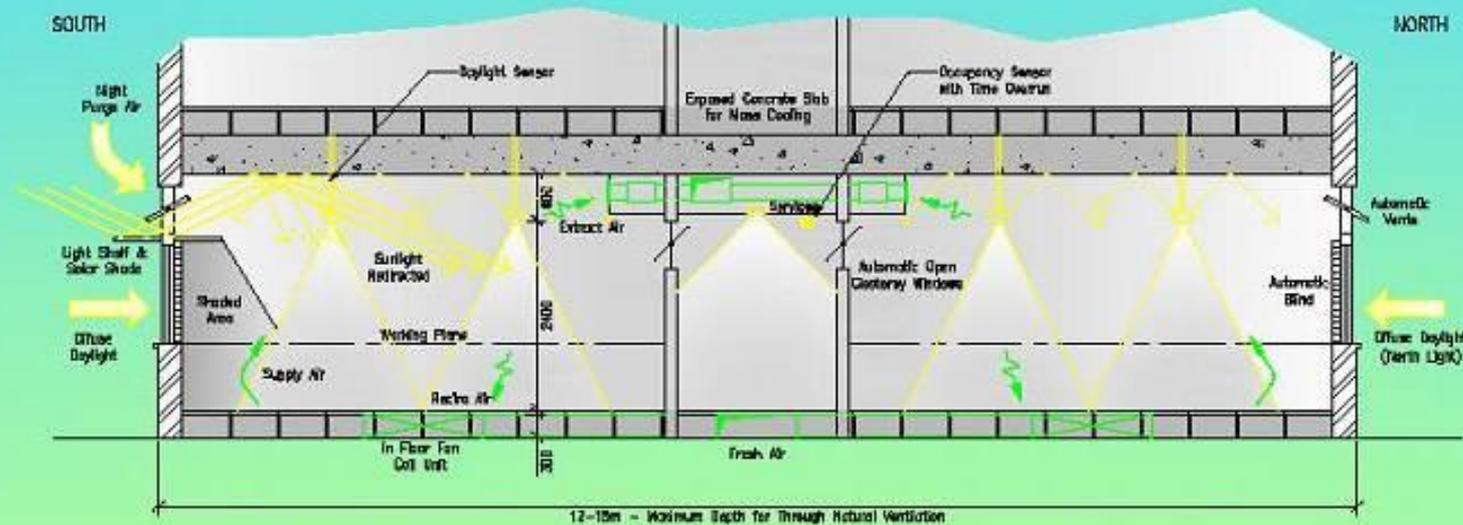
- We need open protocols such as DALI
- We simple yet effective control philosophies.
- We user interfaces that are simple and intuitive
- Our control systems must deliver daylight lumen for electric lumen savings.

Lighting Integration



Case studies

Worked example of good practice daylight design



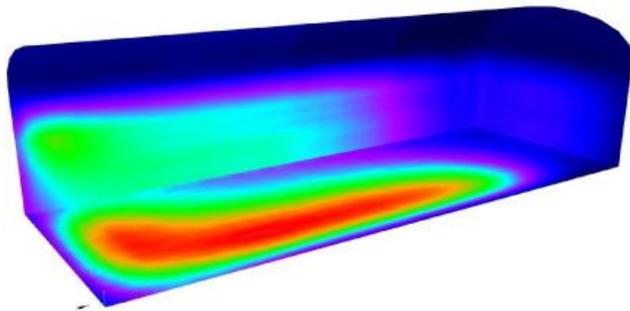
Worked example: Summary

DAYLIGHT FACTOR SUMMARY						
MODEL	% WALL AREA GLAZED	DF AVE	DF MAX	DF MIN	U _o MIN/AVE	DF POINTS => 2%
1 TYPICAL	37%	4.21	17.33	1.20	0.29	64%
2 HIGH WINDOWS	40%	5.25	18.83	1.65	0.31	81%
3 LOW WINDOWS	21%	2.10	23.10	0.30	0.14	24%
4 DEEP PLAN	28%	2.83	13.73	0.75	0.27	42%

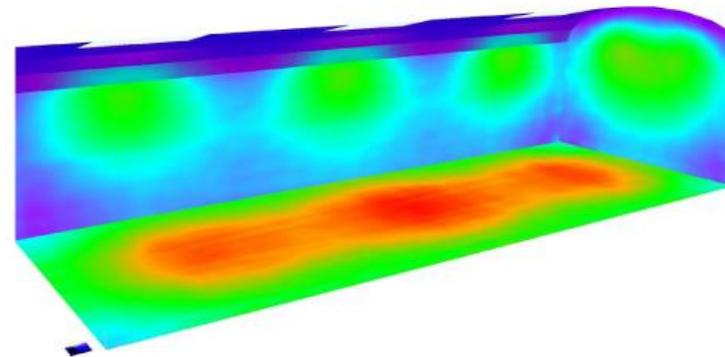
We predict that Model 2 would save in the order of **8153 kWh/yr** which equates to **3441 kg of CO₂/yr**. This represents 80% of the artificial lighting load (based on artificial lighting load of 11w/m² and 8hrs/day daylight)

SAR-H Hanger Options

Hanger (with side windows) / Light scene 1 / False Colour Rendering



Hanger (with rooflights) / Light scene 1 / False Colour Rendering



Cribbs Causeway RSC



Scottish & Southern Energy, Havant



First Floor Plan

Total 1391 desks

Call centre/customer services - 712 hot desks & 236 free standing lockers with 6 individual lockable drawers

(Free standing lockers generically sized at 300x400x1900h)

Customer service - 72 lockers located at desks

Scottish and Southern
Energy plc
Power and Development
Havant

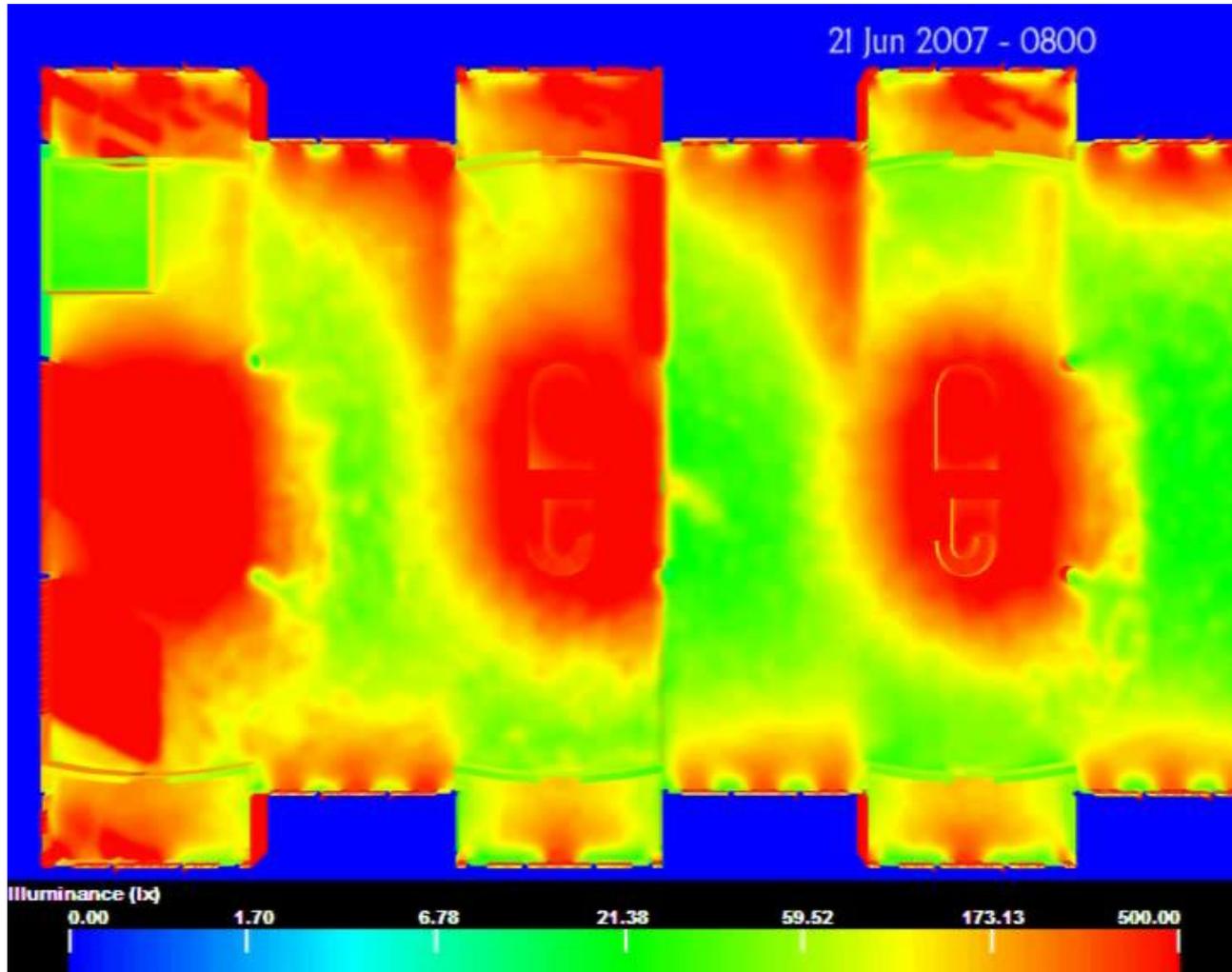
Proposed First Floor Plan
Free Desk Layout

01 01 02 03 04 05 06 07 08 09 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40 41 42 43 44 45 46 47 48 49 50 51 52 53 54 55 56 57 58 59 60 61 62 63 64 65 66 67 68 69 70 71 72 73 74 75 76 77 78 79 80 81 82 83 84 85 86 87 88 89 90 91 92 93 94 95 96 97 98 99 100 101 102 103 104 105 106 107 108 109 110 111 112 113 114 115 116 117 118 119 120 121 122 123 124 125 126 127 128 129 130 131 132 133 134 135 136 137 138 139 140 141 142 143 144 145 146 147 148 149 150 151 152 153 154 155 156 157 158 159 160 161 162 163 164 165 166 167 168 169 170 171 172 173 174 175 176 177 178 179 180 181 182 183 184 185 186 187 188 189 190 191 192 193 194 195 196 197 198 199 200 201 202 203 204 205 206 207 208 209 210 211 212 213 214 215 216 217 218 219 220 221 222 223 224 225 226 227 228 229 230 231 232 233 234 235 236 237 238 239 240 241 242 243 244 245 246 247 248 249 250 251 252 253 254 255 256 257 258 259 260 261 262 263 264 265 266 267 268 269 270 271 272 273 274 275 276 277 278 279 280 281 282 283 284 285 286 287 288 289 290 291 292 293 294 295 296 297 298 299 300 301 302 303 304 305 306 307 308 309 310 311 312 313 314 315 316 317 318 319 320 321 322 323 324 325 326 327 328 329 330 331 332 333 334 335 336 337 338 339 340 341 342 343 344 345 346 347 348 349 350 351 352 353 354 355 356 357 358 359 360 361 362 363 364 365 366 367 368 369 370 371 372 373 374 375 376 377 378 379 380 381 382 383 384 385 386 387 388 389 390 391 392 393 394 395 396 397 398 399 400 401 402 403 404 405 406 407 408 409 410 411 412 413 414 415 416 417 418 419 420 421 422 423 424 425 426 427 428 429 430 431 432 433 434 435 436 437 438 439 440 441 442 443 444 445 446 447 448 449 450 451 452 453 454 455 456 457 458 459 460 461 462 463 464 465 466 467 468 469 470 471 472 473 474 475 476 477 478 479 480 481 482 483 484 485 486 487 488 489 490 491 492 493 494 495 496 497 498 499 500 501 502 503 504 505 506 507 508 509 510 511 512 513 514 515 516 517 518 519 520 521 522 523 524 525 526 527 528 529 530 531 532 533 534 535 536 537 538 539 540 541 542 543 544 545 546 547 548 549 550 551 552 553 554 555 556 557 558 559 560 561 562 563 564 565 566 567 568 569 570 571 572 573 574 575 576 577 578 579 580 581 582 583 584 585 586 587 588 589 590 591 592 593 594 595 596 597 598 599 600 601 602 603 604 605 606 607 608 609 610 611 612 613 614 615 616 617 618 619 620 621 622 623 624 625 626 627 628 629 630 631 632 633 634 635 636 637 638 639 640 641 642 643 644 645 646 647 648 649 650 651 652 653 654 655 656 657 658 659 660 661 662 663 664 665 666 667 668 669 670 671 672 673 674 675 676 677 678 679 680 681 682 683 684 685 686 687 688 689 690 691 692 693 694 695 696 697 698 699 700 701 702 703 704 705 706 707 708 709 710 711 712 713 714 715 716 717 718 719 720 721 722 723 724 725 726 727 728 729 730 731 732 733 734 735 736 737 738 739 740 741 742 743 744 745 746 747 748 749 750 751 752 753 754 755 756 757 758 759 760 761 762 763 764 765 766 767 768 769 770 771 772 773 774 775 776 777 778 779 780 781 782 783 784 785 786 787 788 789 790 791 792 793 794 795 796 797 798 799 800 801 802 803 804 805 806 807 808 809 810 811 812 813 814 815 816 817 818 819 820 821 822 823 824 825 826 827 828 829 830 831 832 833 834 835 836 837 838 839 840 841 842 843 844 845 846 847 848 849 850 851 852 853 854 855 856 857 858 859 860 861 862 863 864 865 866 867 868 869 870 871 872 873 874 875 876 877 878 879 880 881 882 883 884 885 886 887 888 889 890 891 892 893 894 895 896 897 898 899 900 901 902 903 904 905 906 907 908 909 910 911 912 913 914 915 916 917 918 919 920 921 922 923 924 925 926 927 928 929 930 931 932 933 934 935 936 937 938 939 940 941 942 943 944 945 946 947 948 949 950 951 952 953 954 955 956 957 958 959 960 961 962 963 964 965 966 967 968 969 970 971 972 973 974 975 976 977 978 979 980 981 982 983 984 985 986 987 988 989 990 991 992 993 994 995 996 997 998 999 1000

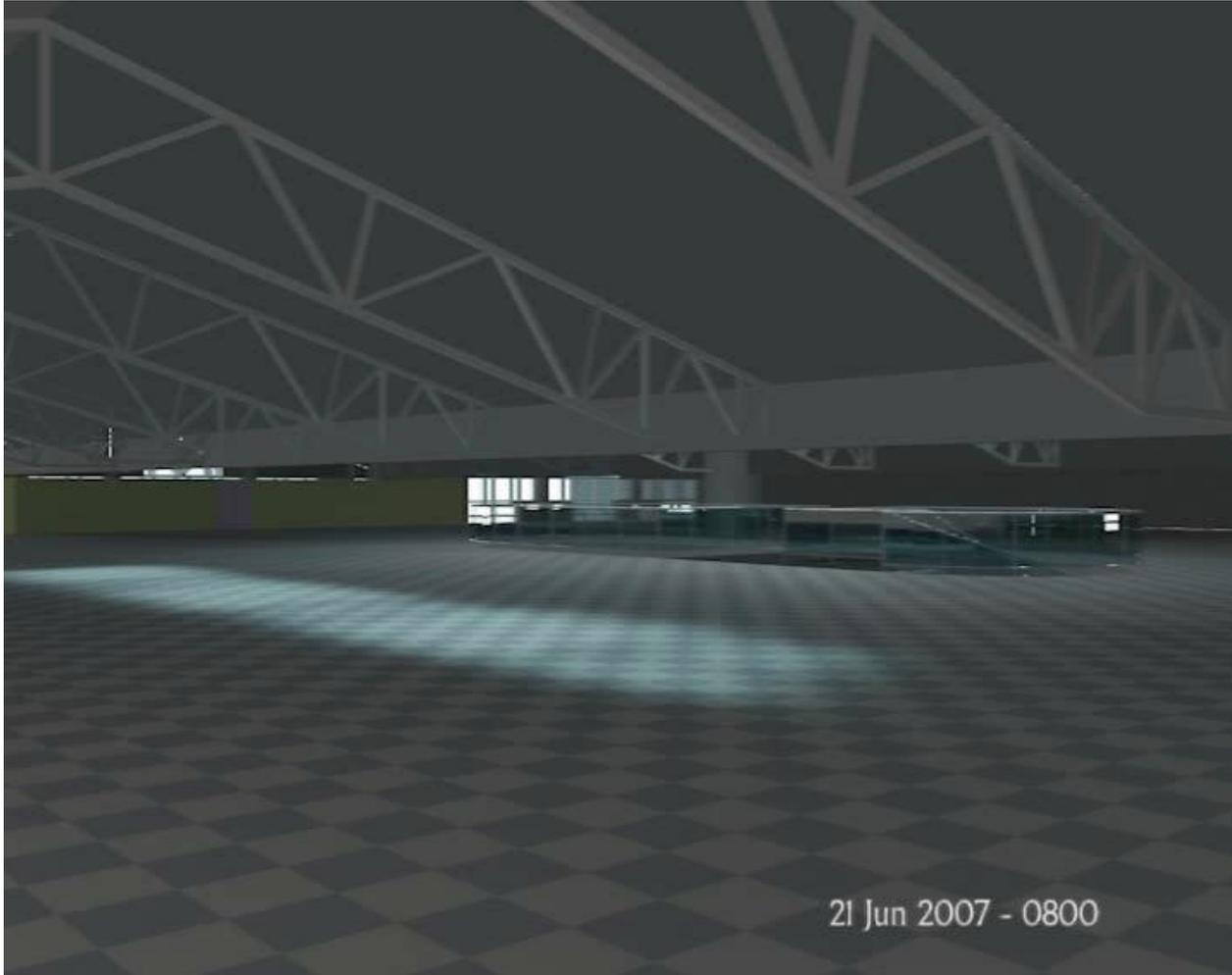
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125 YEARS

Scottish and Southern Energy Havant



Scottish and Southern Energy Havant



Conclusions

- Daylight is a renewable source it is carbon neutral.
- Good daylight design is for all buildings
- Controlled daylight can replace up to 80% of lighting energy consumption during daytime hours.
- Daylight design needs to be combined with intelligent lighting control.
- Increased regulation will limit lighting energy usage. good daylight design will become essential.

Conclusions 2

- The UK should incorporate minimum daylight standards to access carbon savings.
- Daylight design can create dynamic internal visual environments.
- Daylight improves health, wellbeing and attentiveness of occupants
- Lights on blinds down = bad design
- We need a professional to lead on daylight.

Conclusions 3

- Daylight needs coordinated design.
- Artificial lighting design and daylight design are linked.
- Intelligent lighting controls are an essential component of daylight.
- The correct contractual procurement method needs to be entered into to deliver the optimal design.

People *like* natural light



BIM needs to deliver buildings that
can replace electric lumens with
useful daylight lumens

*CINDERELLA STILL HAS HER BALLROOM TICKET IN
HER HAND*

Contact details

Thank you for your attention.

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