NEW ORLEANS BOOK OF FUNDA-MENTALS

Eskew+Dumez+Ripple

2013 First Edition

PURPOSE

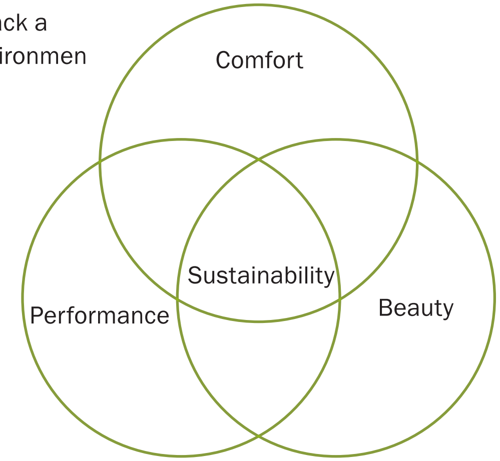
Sustainability is created by combining comfort, performance, and Beauty.

The“New Orleans Book of Fundamentals” is designed to provide project teams with the framework needed to produces high performing buildings in New Orleans and along the Gulf Coast. Part published standards and part original research, the booklet complies information on sustainability from many different sources into one manual. The focus on the information presented is optimization. There are ideal conditions for window to wall rations and shading depth that are unique to New Orleans’s location and climate. These number are not meant to be absolute, but a benchmark with which design teams can compare their designs against. Another emphasis is priority. Some design decisions have a significant impact on the performance of a building, and some have very little. The booklet should help is setting priorities for different sustainability strategies.

The Booklet is only part of the “ N.O. Book of Fundamentals”. To support the information in this book, there are a series of Excel spreadsheet based tools on the server to help project teams make quick sustainable calculations and to track a project during the design process. The toolkit can be accessed on the server at Library>project related>Design>Environmental>Design Tools>Tools.

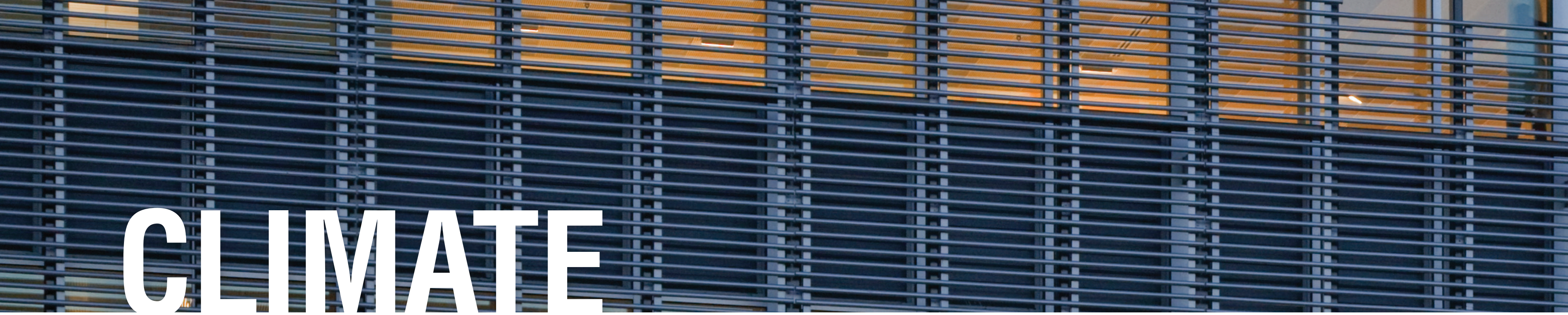
Here, Excel spreadsheet tools will assist in:

- Calculating thermal transmission through the envelope
- Calculate assembly U-values
- Plan for lighting quality and quantity
- Calculate Lighting power density
- Calculate Storm water managed on site
- Cistern sizing
- Calculating potable water reduction
- Creating a simple whole building energy model



WHERE TO START

Minimize Infiltration	☐ Have renovations tested for air tightness
Optimize Insulation	☐ R - 25 c.i. for roofs, R - 19 for walls
Minimize Solar Gain	☐ Provide external shading
Provide Daylighting	☐ Provide optimal window to wall ratios
Provide Controllability	☐ Thermal and lighting
Specify an Efficient HVAC System	☐ Have multiple systems modeled
Manage Stormwater on Site	☐ Use pervious surfaces and provide storage
Reduce Potable Water Use	☐ Specify efficient plumbing fixtures
Decrease Material Waste	☐ Use local and recycled materials
Use High Performance Glazing	☐ VT>60%, SHGC <30%
Control Glare	☐ Separate daylighting and vision windows
Generate Energy	☐ Incorporate solar and / geothermal



CLIMATE

95% of Buildings and 99% of square footage from the 2012 design year are located in New Orleans

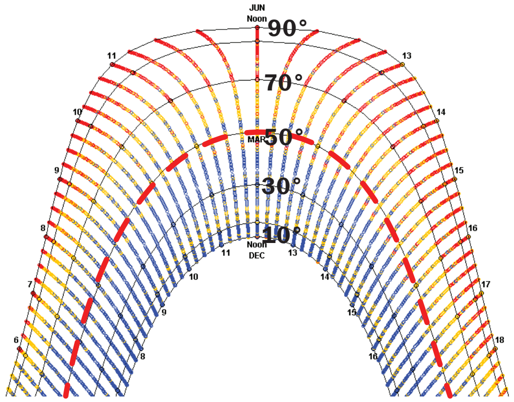
NEW ORLEANS LA

Month	HDD - 65°	CDD - 65°		Sun
January	208	71	Heating	Let in
February	167	57	Heating	Let in
March	37	201	Cooling	Block
April	13	241	Cooling	Block
May	0	432	Cooling	Block
June	0	513	Cooling	Block
July	0	527	Cooling	Block
August	0	505	Cooling	Block
September	0	444	Cooling	Block
October	52	213	Cooling	Block
November	190	49	Heating	Let in
December	243	55	Heating	Let in

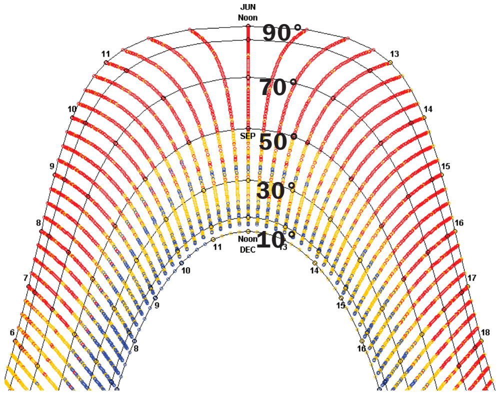
These charts show when and where sunlight should be blocked or let into a building. Each dot represents one hour of the year. A Shade that blocks sun above 50 degrees will block dot above the curved 50° line.

- **Block sun**
- **Block some sun**
- **Allow sun in**

The summer and winter months have very different shading needs. Operable shades (which can be changed at least twice a year) will be more effective than fixed shades.

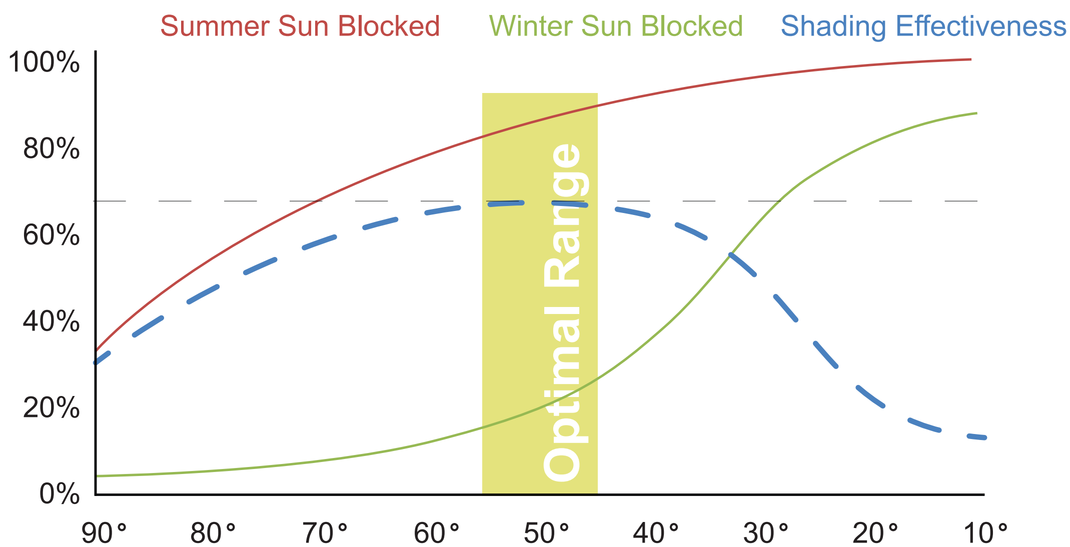


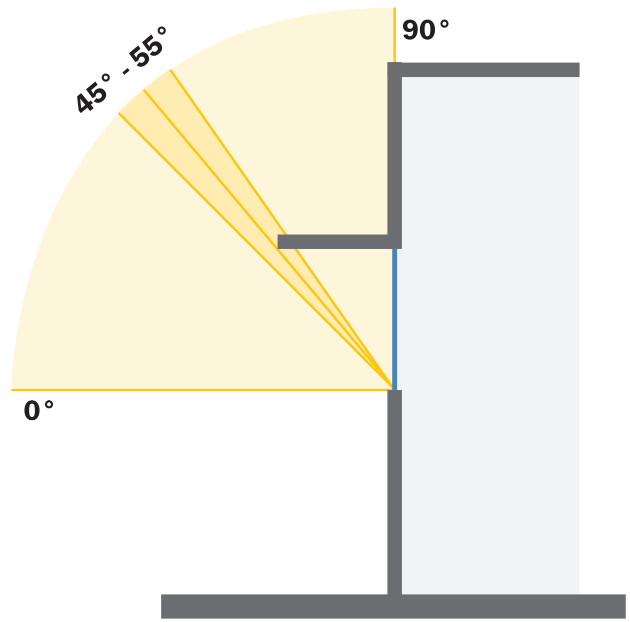
WINTER - SPRING



SUMMER - FALL

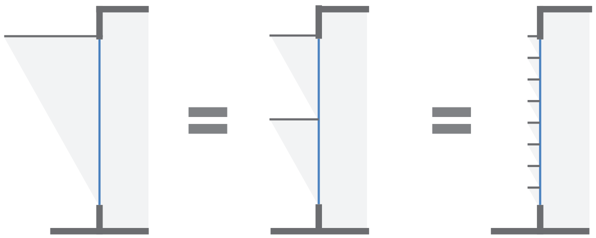
SOLAR CONTROL





On the south, East, and West facades provide overhangs that block sun above 45 to 50 degrees. For each foot of vertical glazing, aim for 8.4 to 12 inches of overhang. Louvers work with the same proportions.

For the East and West facades, vertical fins can be used to supplement shading, but horozontal overhangs shoudl be primary



Shading at multiple scales

ENERGY

Building Type	Site EUI	60% Goal EUI
High School	76*	30
Primary School	66*	26
University Building	120	48
Restaurant	302	121
Hospital	227*	91
Health - Outpatient	84	34
Lodging	87*	35
Office	84*	34
Library	104	42
Fire / Police Station	78	31
Mall	107	43
Retail– non food	92*	37
Multi-Family Residential	49	20
Religious Worship	46	18
Laboratory	360	144

** http://www.energystar.gov/index.cfm?c=new_bldg_design.bus_target_finder*

From 2010 to 2014 we have pledged to reduce energy use by 60% below the benchmark. From 2015 to 2019 the goal will be 70%.

Step 1 - Find your benchmark EUI

Before beginning to design, identify the benchmark for your building type. For numbers with an asterisk, go to "Target Finder" on the Energy Star website for an more accurate benchmark.

Step 2 - Set a goal EUI

Take your benchmark and subtract 60%. This is your EUI target. If there is reason that your building can not achieve a 60% reduction, set an ambitious, yet realistic goal.

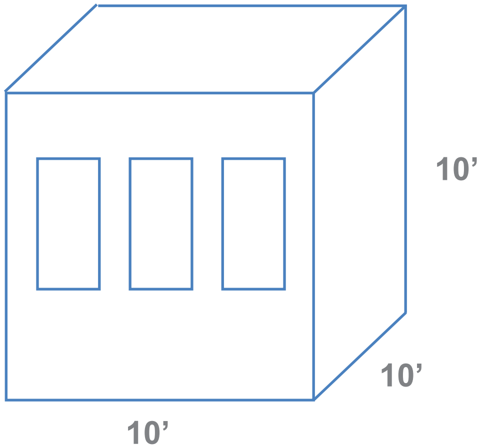
Step 3 - Verifify EUI

energy models will verify that you are on track for your goal EUI. Have an energy model conducted during each phase of the project and ask for more than one wall assemply, glazing system or mechanical system to be modeled for comparison.

ENVELOPE

Infiltration

Infiltration, air leaking through the envelope, can account for more than a third of a building's energy use in a hot-humid climate. Infiltration is meastured in air changes per hour (ACH). A tight builing might have 0.5 ACH, while a leaky buiding might have 1 to 2 ACH. The differnce in total energy use between the same building with 0.5 ACH and 2 ACH might be as high as 50%. If the project is a renovation of an existing building, creating a tight shell should be the number one goal. All renovations or existing builings need to be tested for air tightness.



Conduction

Insulation can go a long way to improving energy efficiency, but walls alone may not be the largest driver of energy use. To determine where to invest in added insulation, it is helpful to calculate a UA for the building. Divide 1 by the R - Value for each assembly to calculate the U - Value. Then multiply the U - Value by the area to find the UA. Sum up the UA for the entire building to find the total UA. The lower the UA, the better.

In the example below, 80% of the heat Gain (or loss) is through the windows. In this case, adding additional insulation to the walls would have very little benefit, while improving the windows would significantly improve energy performance.

	R - Value	U - Value	Area (sf)	UA	% of UA
Walls	19	0.05	350	18.4	15%
Glazing	0.5	2.00	50	100	80%
Roof	30	0.03	100	3.3	3%
Floor	40	0.03	100	2.5	2%
				UA - Total	
				124.3	

TOOL - See "Thermal Conductance Worksheet" in the sustainability tools folder

INSULATION

More Insulation is better. Aim for R - 20 C.I. roofs and R - 19 walls.

Space Type	Situation	Best Practice	Code Minimum
Roofs	Above Deck	R - 20 c.i.	R - 20 c.i.
	Metal Building	R - 26	R - 19
	Attic	R - 38	R - 38
Walls	Mass	R - 5.7 c.i.	R - 5.7 c.i.
	Metal Building	R - 16	R - 13
	Steel Framed	R - 13	R - 13
	Wood Framed	R - 13	R - 13
Floors	Mass	R - 6.3 c.i	R - 6.3 c.i
	Steel Joist	R - 19	R - 19
	Wood Framed	R - 19	R - 19

* C.I. - Continous Insulation - not interupted by framing
* For New Orleans, the best practice and code minimum insulation values are very similar
* The values above are for insulation, not assembly

Conditioning a space is a balance between adding heat (or removing it) and conduction loss through the envelope. To improve comfort you can either use more energy or waste less. Additional insulation and more air conditioning will both have the exact same effect on comfort.

Polystyrene	R - 4 / Inch
Polyurethane	R - 6 / Inch
Polyisocyanurate	R - 7 / Inch

GLASS SELECTION

Glass Metrics	
VT	The amount of visible light that is transmitted through the glass. A VT of 0 is completely opaque while a VT of 1 would be completed transparent.
SHGC	The Solar Heat Gain Coefficient is the fraction of the sun's energy transmitted through the glass. In a hot climate, a lower number is better.
UV Transmittance	The amount of UV radiation that is transmitted through the glass.
U - Value	The amount of heat that is transmitted through the glass. A lower value is more insulating
LSG	Light to Solar Gain Ratio is calulated by dividing VT by SHGC. This is the about of light transmitted per unit of heat. For a hot climate, the higher the better. Choose LSG > 2.0
Emissivity	The ability of a material to radiate heat. Clear glass has a very high emissivity, 0.85 to 0.95. Low E glass can be .4 to .05. in a hot climate, lower in better.

TOOL - Use CONFEN to calulate optimal window choices

For Vision zone
3' -7' AFF

Keep VT below 0.4 to avoid glare choose a low SHGC.

For Daylighting
>7' AFF

Choose a glass with a high VT and the highest possible LSG

For Glass Facades

Emphasize a low SHGC, low emissivity, and a low U-Value.

For Passive Solar

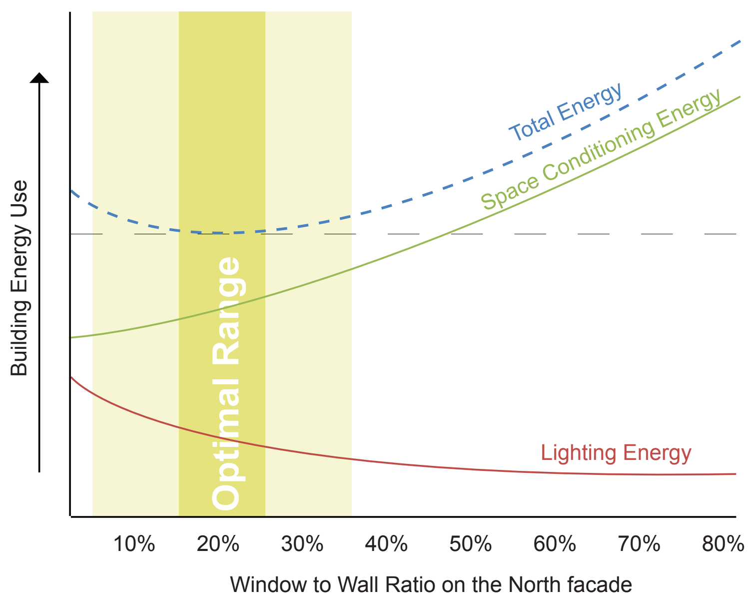
Emphasize a high SHGC, low U-Value, and optimal exterior shading.

GLAZING

In New Orleans, the most efficient window wall ratio for a north facade is 15% to 25%

Glazing for daylighting

Small windows will save energy by daylighting while not contribute to very much to thermal transmission. Once the Window to wall ratio (WWR) exceeds 35% on the north facade, there is little additional benefit from daylighting while heat gains accelerate. Adding shading on the South, east, and west Facade will allow more glass for the same energy consumption.



Energy cost of an all-glass facade over optimal WWR

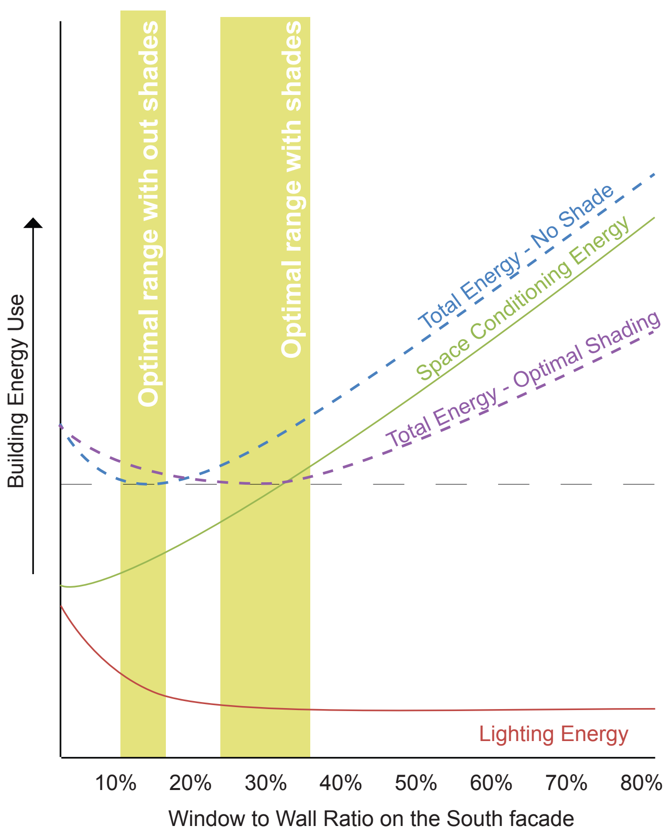
North	1.8 Time more energy
South	2.6 Times more energy
East	2.8 Times more energy
West	2.8 Times more energy

Best distribution of glazing for optimzing energy and daylighting

Facade	No Shade	Shades
North	42%	24%
South	26%	33%
East	16%	21%
West	16%	21%

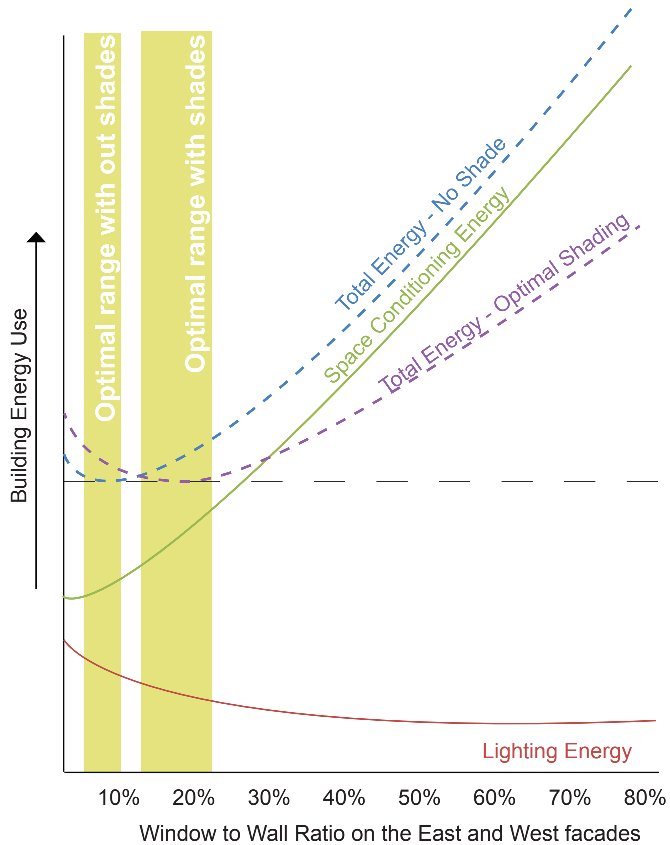
South Facade

With shades - Glaze between 25% and 30%
Without shades - Glaze between 10% and 15%



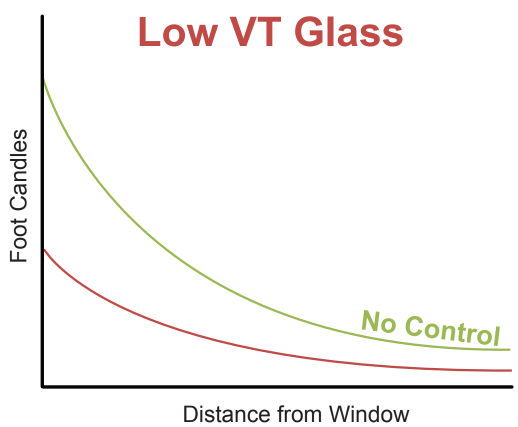
East / West Facade

With Shades- Glaze between 15% and 20%
Without shades - Glaze between 5% and 10%

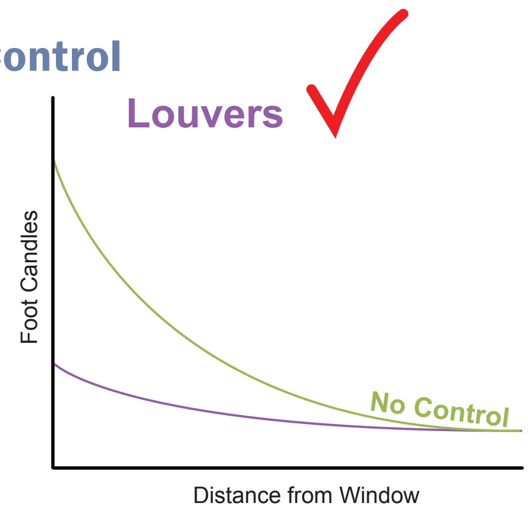


GLARE

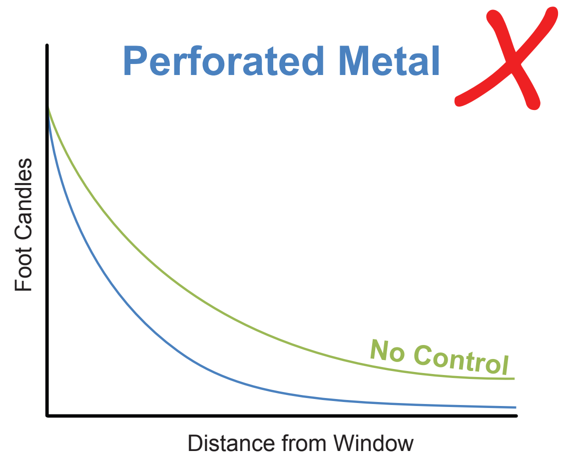
Three Strategies for Solar Control



Low transmitting glass will reduce light levels proportionally throughout the space.



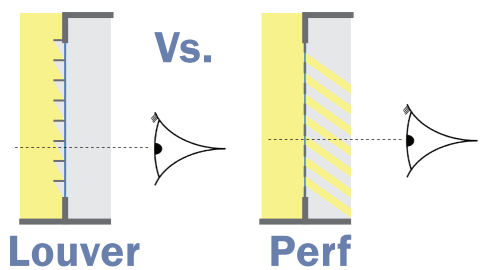
Louvers will decrease light level by the windows and allow light to bounce further into the space, creating more even lighting.



Perforated metal does little to reduce light levels by the windows, but then prevents light from penetrating deep in the space. This creates uneven lighting.

Reasons to Avoid Perforated Metal in the Vision and Daylighting Zones

1) No glare control
2) Less daylight for the same thermal conduction
3) Creates harsh light contrast during the day
4) Prevents views at night
5) Creates uneven daylighting
6) Expensive - One facade for the price of two



CONTROLLABILITY

More Controls = More Comfort = Less Waste

Comfort cannot be achieved through engineering alone. To provide 100% comfort, people need to be given the means to alter their own environment. In 2000 years, let's see how far we've come.

The Pantheon is a net zero building. The climate in Rome Is such that with adequate internal gains and ventilation comfort can be achieved 57% of the time. (The exact same percentages New Orleans) Over the course of the year, the Roman priests who worked here were comfortable 57% of the time.

EDR's Office uses significantly more energy then the Pantheon. During the summer of 2012, a survey confirmed that only 17% of the office was comfortable. In theory, a sealed, heated and cooled space should provide comfort 100% of the time. In practice, this is not the case. Operable windows, individual thermostats, and micro-climates can provide more comfort for less energy.

PASSIVE SYSTEMS

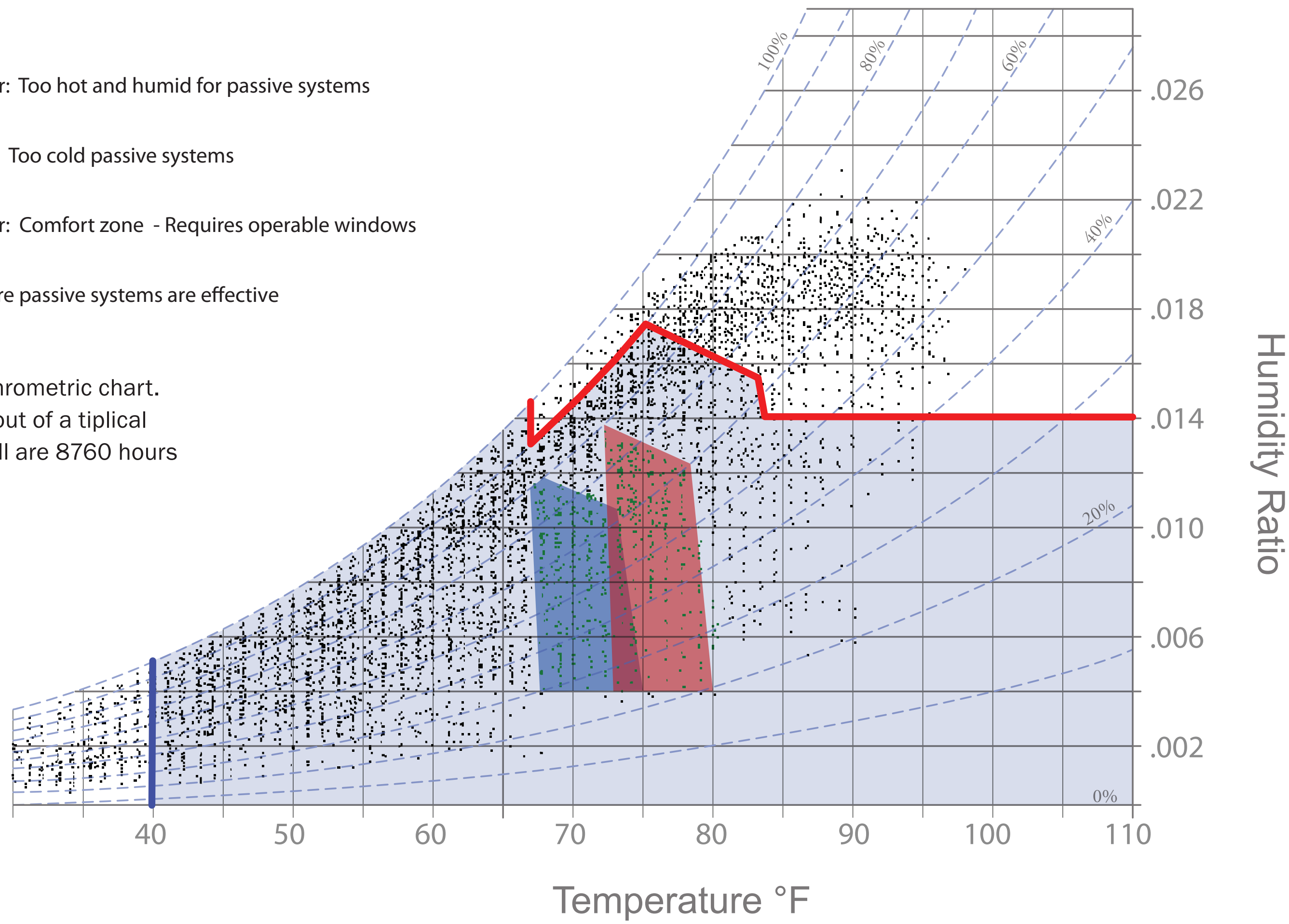
27% of the year: Too hot and humid for passive systems

5 % of the year: Too cold passive systems

11% of the year: Comfort zone - Requires operable windows

57% Area where passive systems are effective

Each dot on the psychrometric chart. represents one hour out of a tiplical meterologocal year. All are 8760 hours are represented.

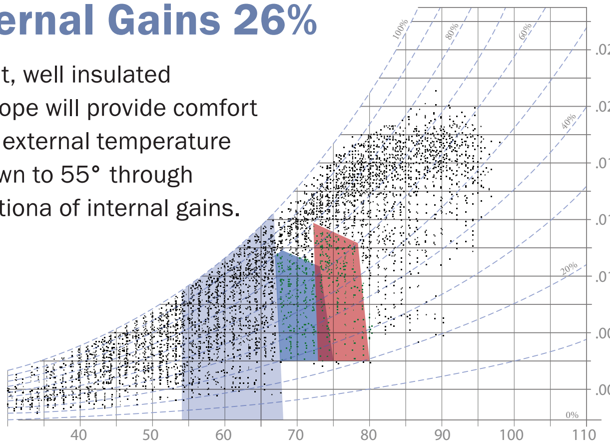


New Orleans passive Strategies

57% of the year in New Orleans, comfort can be achieved through passive systems alone. A well insulated building with operable windows, ceiling fans, and optimal shading can take advantage of all these strategies. Traditional southern arctiecture like the plantation house above emphasized these three strategies to mazimize comfort without electricity.

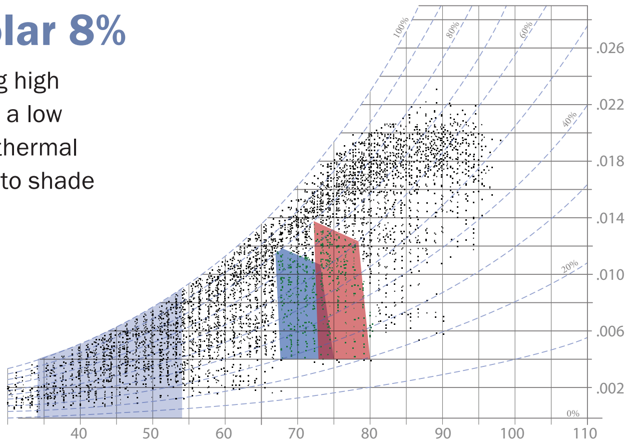
Internal Gains 26%

A tight, well insulated envelope will provide comfort at an external temperature of down to 55° through retentiona of internal gains.



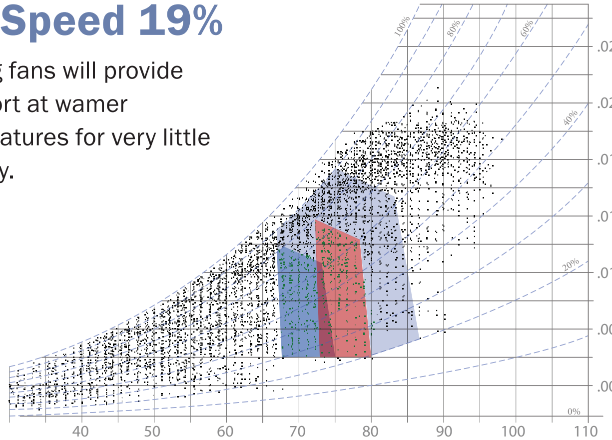
Passive Solar 8%

Provide south facing high SHGC windows with a low U-value and a high thermal mass floor. Be sure to shade optimally.



Air Speed 19%

Celing fans will provide comfort at wamer temeratures for very little energy.



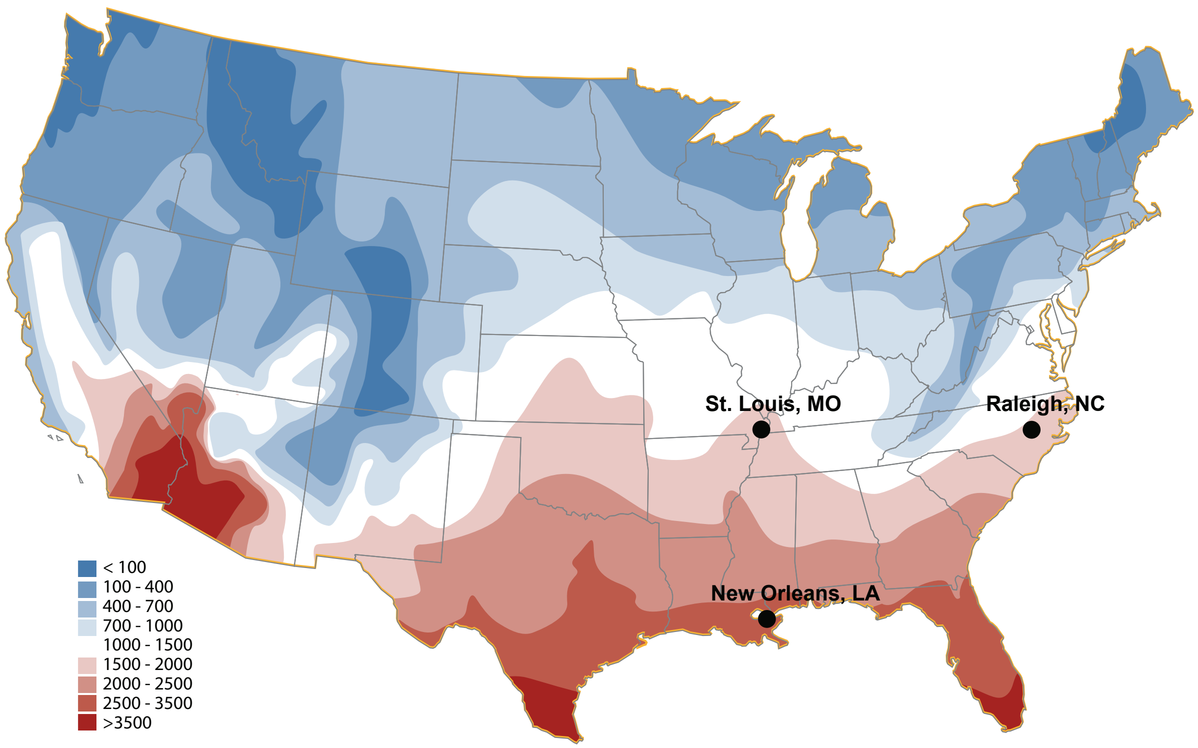
AIR MOVEMENT

Fan Forced Ventilation

Running a fan during the summer can make the indoor temperature feel 5 degrees cooler. This allows the air conditioner to be run less often and at a higher set point. In terms of occupant comfort, air movement can reduce new Orleans' cooling degree days by 39%, making the cooling load similar to St. Louis, MO or Raleigh, NC. Combining ceiling fans and air conditioning can save around 32% over air conditioning alone.

Natural Ventilation

Natural ventilation will have limited effects in New Orleans due to low wind speeds and no prevailing wind direction. This strategy only be used for very thin floor plates (<15' from a window) or rooms with windows on 2 sides.

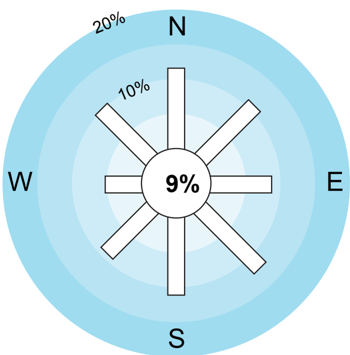


New Orleans cooling degree days - 2776

CDD equivalent with air movement - 1619

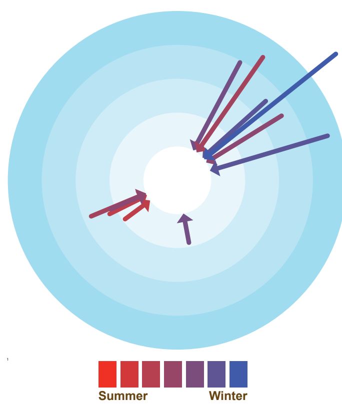
WIND

Wind Rose



Winds in new orleans come from all directions relativly equally. 9% of the time there is no wind at all

Wind Vectors



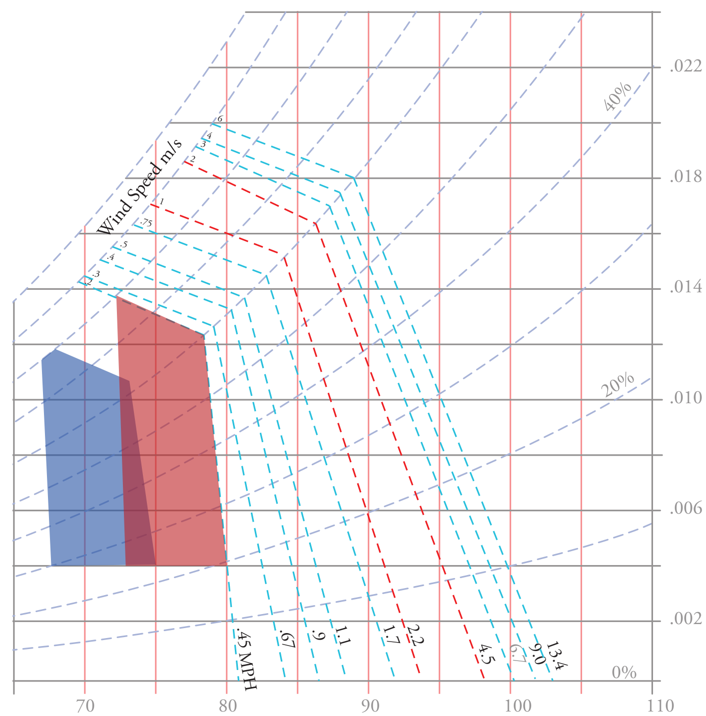
Broken down by month, there is a slight pattern of wind coming from the north east during the winter and the southwest during the summer.

Average Wind Speed - 7.5 mph

New Orleans has less wind than it may seem. Passive ventilation strategies should be supplemented with fans.

Compared to 275 American cities, New Orleans ranks in the bottom 35th percentile for wind speeds, and the 12th percentile of summer wind speed.

Expand the comfort zone



Increasing air speed can provide comfort at warmer temperatures. People tend to be comfortable with up to 2.2 mph indoors and up to 4.5 mph outdoors. Some air flow is always required. Air flow below 0.45 mph will feel stuffy at any temperature.

LIGHTING

All projects should aim for a 25% decrease in LPD (W/sf) under the 2030 commitment.

Space	Area (sf)	IES Goal (fc)	Desired Light Quality	Desired Light level (fc)	Goal LPD
Kitchen	200	50 - 100	Well lit at work stations	60	1.6 W/sf
Dining Room	600	5 - 20	Atmospheric	5	0.5 W/sf

TOOL - See "Lighting Design Worksheet" in the sustainability tools folder

Setting Lighting Goals

For each project, keep a running list of each different space and its respective lighting quality and quantity goals. We require our engineers to work from this matrix.

Controllability

Lighting should be designed to provide maximum controllability. All spaces need to be equipped with over-ridable occupancy and daylight controls.

Lighting can account for 20% to 30% of energy use.

Space Type	Average LPD	Goal LPD
Convention Center	1.22	0.92
Restaurant	1.6	1.20
Dormitory	1.02	0.77
Hospital	1.23	0.92
Library	1.29	0.97
Multi-Family Residential	0.66	0.50
Museum	1.11	0.83
Police / Fire station	1.0	0.75
Parking garage	0.27	0.20
Retail	1.5	1.13
Religious	1.28	0.96
Office	1.0	0.75
School	1.2	0.90

TOOL - See "LPD Worksheet" in the sustainability tools folder

STORM WATER

In New Orleans, 6” of rain falls during a 2 year 24-hour storm event. Projects should set a goal of managing at least 60% of this event.

Surface Type	Runoff Co.
Asphalt	0.9
Concrete	0.9
Brick	0.8
Roof	0.89
Grass pavers	0.2
Pervious Concrete	0.3
Lawn / Heavy Soil – Flat <2%	0.17
Lawn / Heavy Soil – Medium 2% - 7%	0.22
Lawn / Heavy Soil – Steep >7%	0.35

To calculate stormwater managed on-site:

1) Multiply the total site area by .5’ to get the total rainfall in cubic feet

2) Multiply the area of each site material by its runoff coefficient and by .5’ to get the total site runoff.

3) Subtract any additional water storage from the runoff

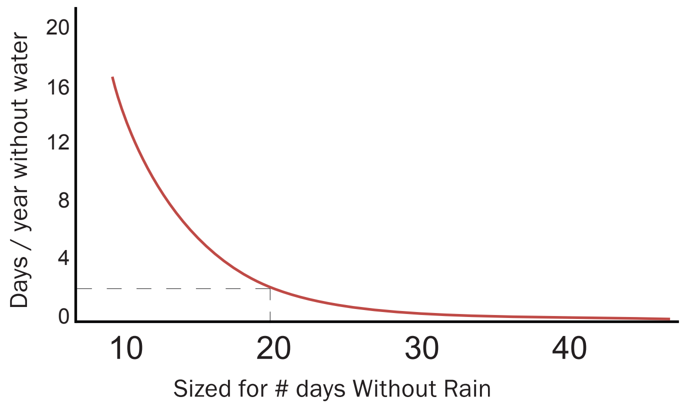
4) Divide the total run off by the total rainfall

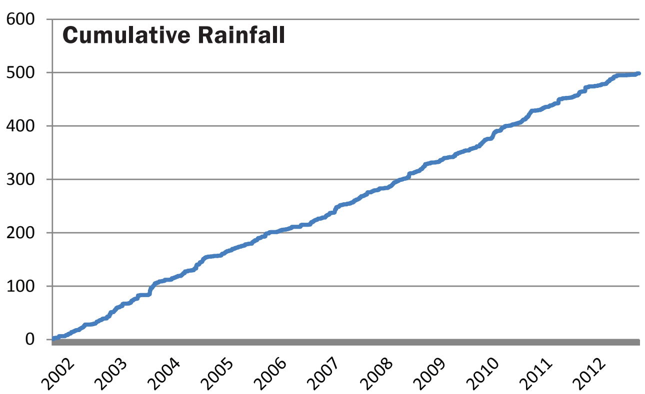
			Total rainfall (cf)	Total Runoff (cf)
	Runoff Coefficient	Area (sf)	sf * .5'	Runoff Co. * SF * .5'
Grass	0.17	2000	1000	170
Asphalt	0.9	1500	750	675
Grass Pavers	0.2	500	250	50
Roof	0.9	1000	500	450
		Total	5000	1345
		Additional Storage (cf)		500
		Total Runoff		845
		Percent Maintained		83%

TOOL - See "Stormwater management wokrsheet" in the sustainability tools folder

CISTERNS

New Orleans's Long term rainfall average is 0.125" per Day





TOOL - See "Cistern Worksheet" in the sustainability tools folder

Cistern Goal 1: Watering Plant During Droughts

On average, a drought in New Orleans (one week or more with no rainfall) occurs 14 times a year and averages 8 days in length, with the longest drought in the last 20 years being 46 days. These events are spaced relatively evenly. To size a cistern to hold water during droughts, calculate the daily demand in gallons (for landscaping) and multiply by the number of days you want to have water. A cistern with 10 day water supply will be empty two weeks out of the year. a 30 day supply will be empty only once every other year.

Cistern Goal 2: Slow Percolation of Stormwater

Cisterns can be used to detain rainfall events and then let this stored water slowly percolate back into the soil, thus decreasing the load on the city's pumps. To maximize percolation, the cistern should drain 0.125 inches per day, the same as the long term average rainfall. Calculate the total volume of water that would be collected by a cistern from a 0.125" rain event. Set the valve on the cistern so that this quantity is drained each day.

POTABLE WATER

64% of municipal carbon emissions in New Orleans are generated by the Sewage and Water Board

LEED requires potable water to be reduced by at least 20% for all projects and awards up to 4 points for additional reduction up to 40%. Every project should achieve easily 20% and most projects should be able to reduce more.

Uses per Pay	Toilet	Urinal	Sink
Male FTE	1	2	3
Female FTE	3	0	3
Male Transiant	0.1	0.4	5
Female Transiant	0.5	0	0.5

Gallons per Fixture	Standard	Efficient	% Reduction
Toilet	1.6	1.28	20%
Urinal	1	0.5	50%
Sink	0.125	0.1	20%
Showerhead	2.5	1.5	40%

TOOL - See "LEED Water Efficiency Worksheet" in the sustainability tools folder

To Calculate water Potable water reduction:

1) Determine, or estimate, the total number of occupants, both full time equivalents and visitors (transients). Assume a 1:1 male to female ratio unless there is a reason to think otherwise.

2) Calculate the baseline water usage by multiplying the number of uses per day for each fixture type by the gallons per use of a standard fixture

3) Choose efficient fixtures and multiply uses per day by gallon per use of efficient fixtures.

4) Divide #3 by #2 to find the percent reduction.

Note1: All commercial sinks will use 0.5 GPM, so water reduction comes from adding an automatic shut off. Average use is 15 seconds, or 0.125 Gallons without a shut off, and 12 seconds, or 0.1 Gallons with an shutoff.

Note2: Since urinals provide the greatest water reduction, a building full of male transients would provide the greatest reduction.

Note3: Avoid duel flush toilets. They use the same amount of water on averge as high efficiency toilets with, less confusion

MATERIALS - TOXINS

The Living Building Challenge provided a list chemicals that should not be part of the built environment. The list contains carcinogens, mutagens, and other hazards. Find out what chemicals are in the materials that you specify.


the REDLIST

The Living Building Challenge publishes a "Red List" of materials to be avoided in buildings seeking certification under the Living Building Challenge. What's on it?

● Asbestos ● Cadmium ● Chlorinated Polyethylene and Chlorosulfonated Polyethlene ● Chlorofluorocarbons (CFCs) ● Chloroprene (Neoprene) ● Formaldehyde ● Halogenated Flame Retardants ● Hydrochlorofluorocarbons (HCFCs) ● Lead ● Mercury ● Petrochemical Fertilizers and Pesticides Phthalates ● Polyvinyl Chloride (PVC) ● Wood treatments containing creosote, arsenic or pentachlorophenol ●

Living building red list

Polyvinyl Chloride

PVC off gasses over time and can causes health problems. Releases aerosol Lead when burned.

CFCs and HCFCs

Used as refrigerants. Small quantities have a huge impact on depleting the ozone layer

Formaldehyde

Common in carpet, plywood, and varnishes, and glue. Causes cancer and many health issues.

Heavy Metals

Cadmium, lead, and mercury are common in old buildings and in New Orleans's soil. a shoe bench or a walk off mat should be provided to limit contamination.

Treated Wood

Wood is often treated with many hazardous chemicals. Be sure to specify Low VOC wood.

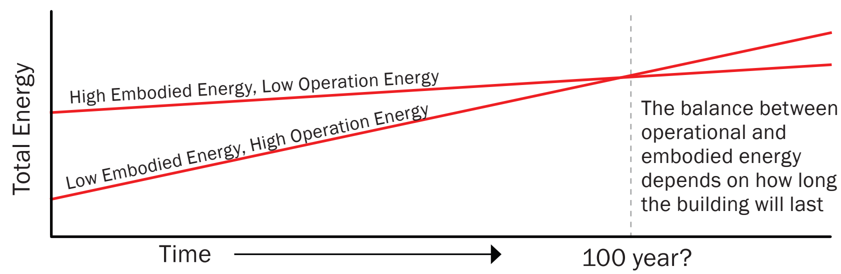
MATERIALS - ENERGY

Three beams of equal strength

Relative to other structural systems, Steel framing has a high embodied energy. Per unit of strength, concrete has half the embodied energy of steel. Glulam is even lower at one sixth the embodied energy of steel.

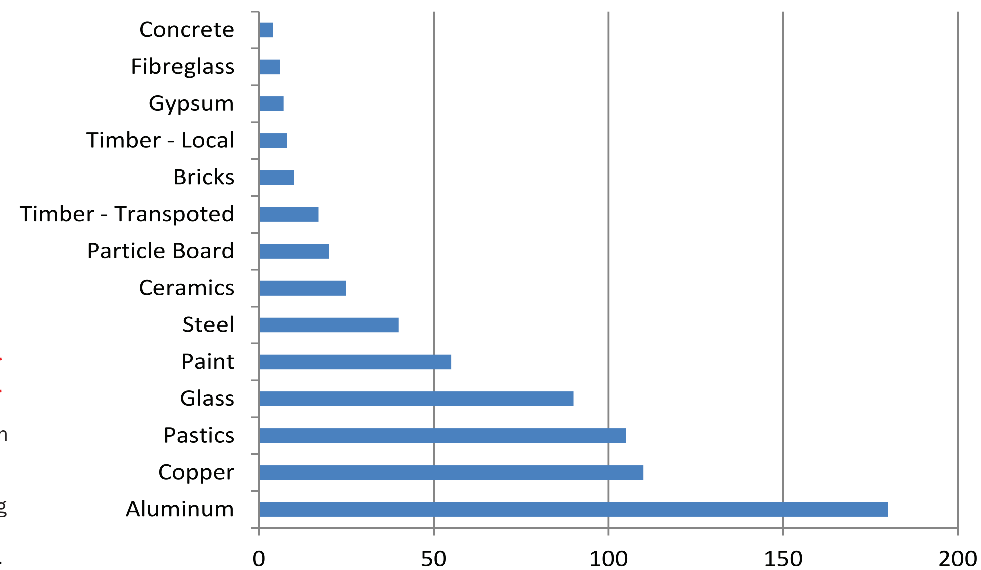
MATERIAL	ENERGY PER UNIT OF STRENGTH
Steel	1.0
Concrete	0.49
Glulam	0.16

Embodied Energy v Operation Energy



EMBODIED ENERGY OF BUILDING MATERIALS MJ/KG

Choose materials with lower embodied energy



TRANSPORTATION

In the United States, Buildings use 50% of all energy. Transportation uses another 25%. Sustainable buildings require sustainable transportation systems.

Bicycle Transportation

New Orleans's climate makes bicycle transportation easy for the majority of the year. Every project should make an effort to encourage transportation by bicycle through the following means.

- Covered, secure bike racks
- Showers, lockers, and changing facilities
- Off street bicycle paths
- Minimal car parking and other incentives

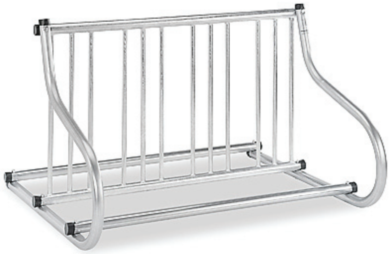
LEED requires bicycle parking for 5% of FTEs. We should provide spaces for at least 15% of FTEs.

Integrated Indoor storage example

Bike Parking Guidelines

Integrate bicycle parking and access into the design and site plan.

Specify bike racks that hold one or two bikes, rather then 5 or 10. Make sure that the rack allows bikers to easily lock both wheels.



Avoid this

Choose this

RESILIENCE

Things to think about...

What happens if the power goes out for a week in July? in January?
Can the building still be used comfortably?

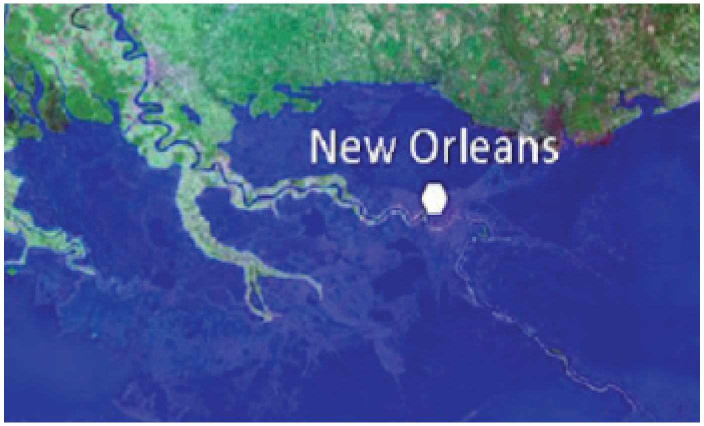
What if the city floods or the sea level rises?
Will the building be damaged?

How long will be building last?
How will the world change over that time period?

How will infrastructure and transportation function?
Can the building remain relevant?

How will utilities be supplied in the future?
Can the building adapt?

50 years from now...
Will the building be part of the problem or part of the solution?



New Orleans 2100 - Many of our buildings will still be around. How can we plan for this?

CERTIFICATIONS

We will track all projects against both a COTE questionnaire and a LEED check list. An updated COTE Questionnaire must be pinned up at every design review.

AIA COTE Top Ten

COTE considers ten different but interconnected sustainability categories. Every project should address each of the categories in an intentional way.

1) Design & Innovation
2) Regional / Community Design
3) Land Use & Site Ecology
4) Bioclimatic Design
5) Light & Air
6) Water Cycle
7) Energy Flows & Energy Future
8) Materials & Construction
9) Long Life, Loose Fit
10) Collective Wisdom & Feedback Loops

LEED

Whether or not a client wants to pursue LEED certification, all projects should be designed to LEED Silver equivalent. The following credits should be achievable in every project.

SS Credit 4 - Alternative Transportation
SS Credit 7 - Heat Island Effect
WE Credit 1 - Water Efficient Landscaping
WE Credit 3 - Water Use Reduction
EA Credit 5 - Measurement and Verification
MR Credit 5 - Regional Materials
MR Credit 7 - Certified Wood
IEQ Credit 1 - Outdoor Air Delivery Monitoring
IEQ Credit 4 - Low Emitting Materials
IEQ Credit 6 - Controllability of systems
IEQ Credit 8 - Daylight and Views

RESEARCH & DATA

At Tulane's Howard Tilton Memorial Library, The average stack aisle is used 3% of the time, but the lights are left on 100% of the time.

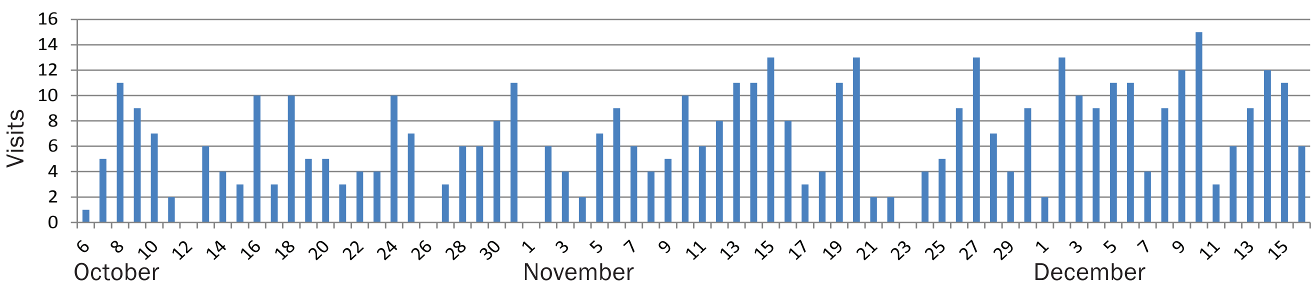
Data Based Design

Having real data on occupancy, use and comfort can impact design and improve performance. If a project is a renovation, data should be collect from the existing building. for new construction, data can be collect on similar building types in the city.

What we can collect:

- Temperature, % RH, light levels
- Volume and time of use
- Ventilation rates
- Energy use
- Comfort Feedback
- Solar radiation
- Airspeed
- Differential pressure

Example of occupancy data: HTML average stack visits over 3 months



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