

Final Project

A Presentation by: Mahdi Afkhamiaghda

Dune Villa

Architects: Hilberinkbosch architects

Project Year: 2014



Building Type: Single family residential

Site Area: 22300 SF (0.5 Acre)

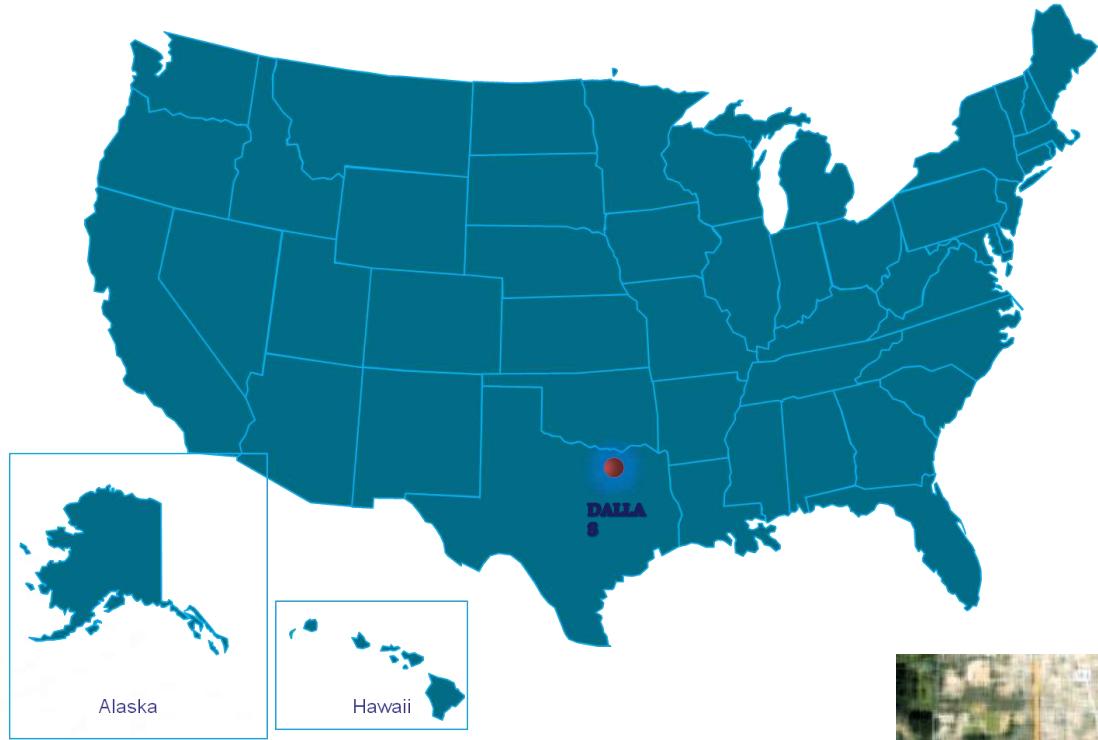
Building Area: 7600 SF(%34 of the Site)

Status of the Site: Previously disturbed, with building

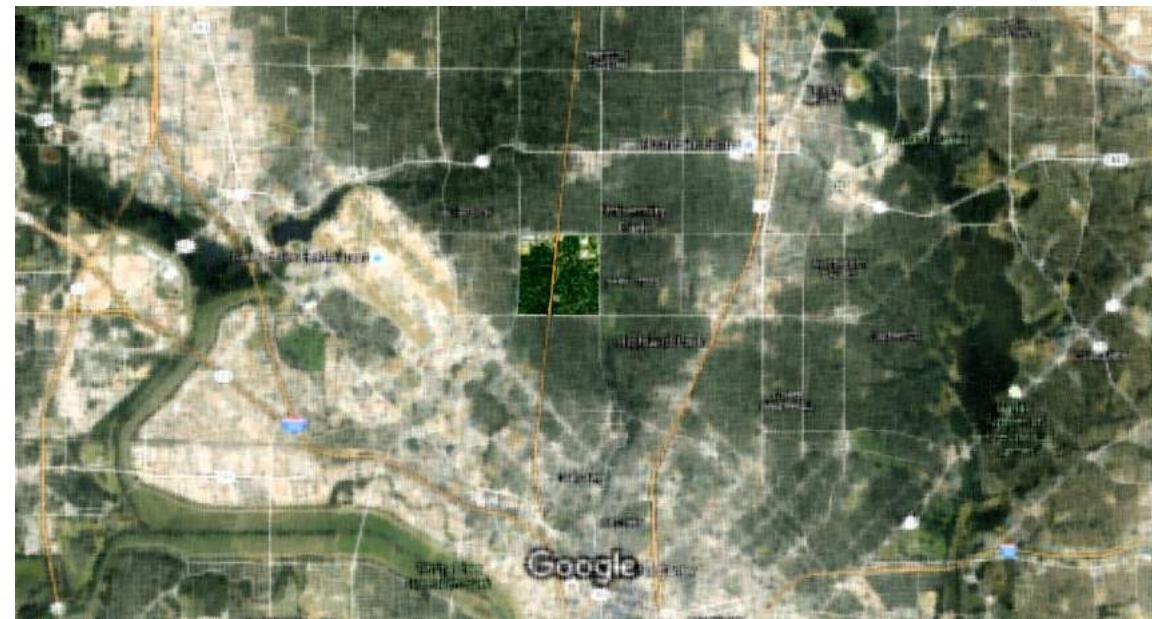
Number of Floors: 2

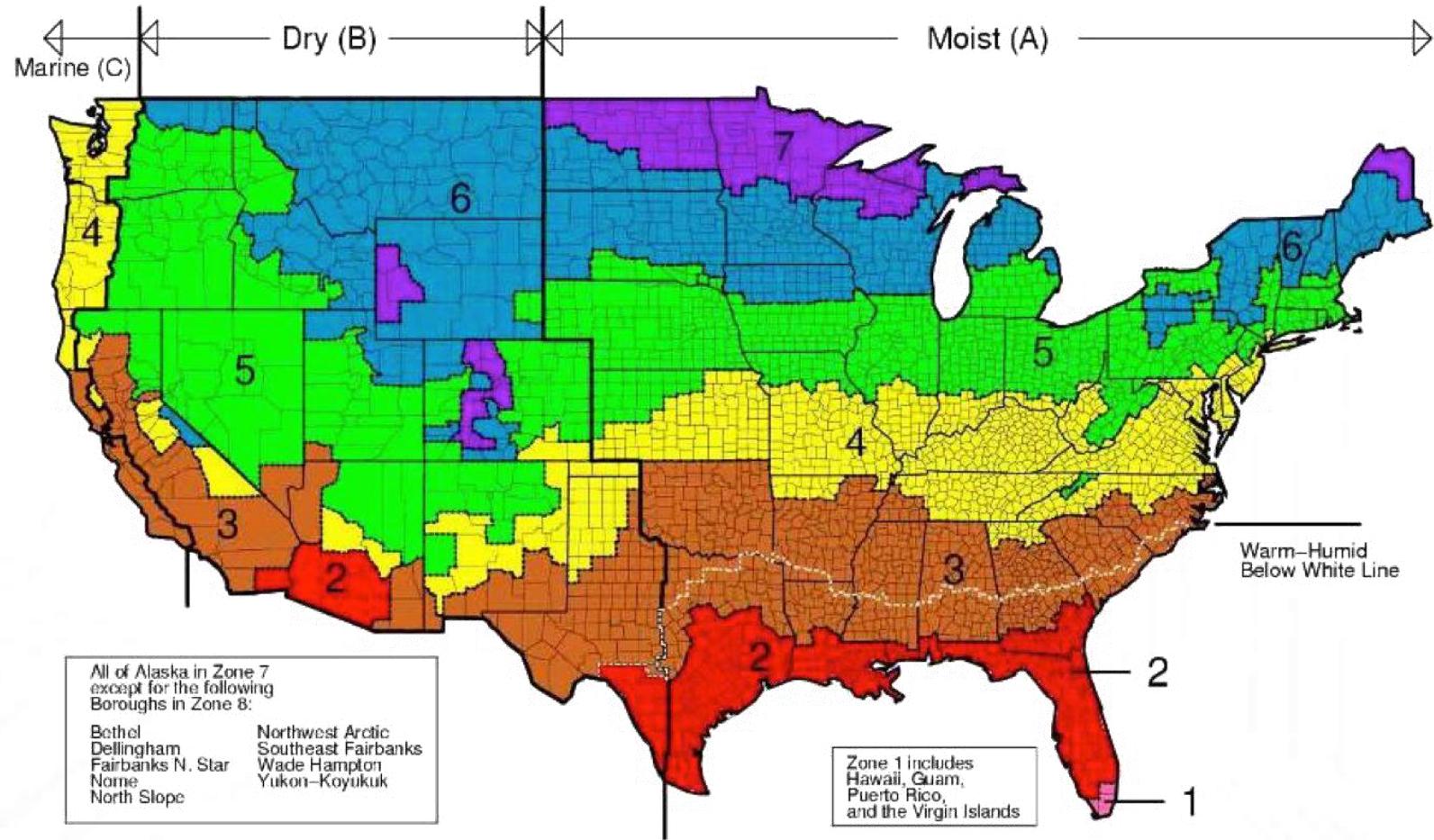
Type of Construction: Concrete

The building is oriented on the East-west long axis



The project is a residential building located on 5647 W Amherst Ave , Dallas, Texas, USA





According to US department of energy climate map, Dallas is considered as a warm and humid place.

For the purposes of climate analysis and thermal simulation data has been taken from the Energy Plus Weather Database which uses annual hourly IWEC1 data collected for WMO Station 722583, TMY3 Dallas-Love Field International Airport. Data provided by ASHRAE with Energy Plus Weather Data.

http://apps1.eere.energy.gov/buildings/energyplus/weatherdata/4_north_and_central_america_wmo_region_4/1_usa/USA_TX_Dallas-Love.Field.722583_TMY3.zip

This weather station is located adjacent to the site at an altitude of 439 ft., at
96°85'W: 32°85'N

As shown in fig 1, Dallas has a continual temperature through the year, which implies the importance of using good isolation and materials with a high R value in the building.

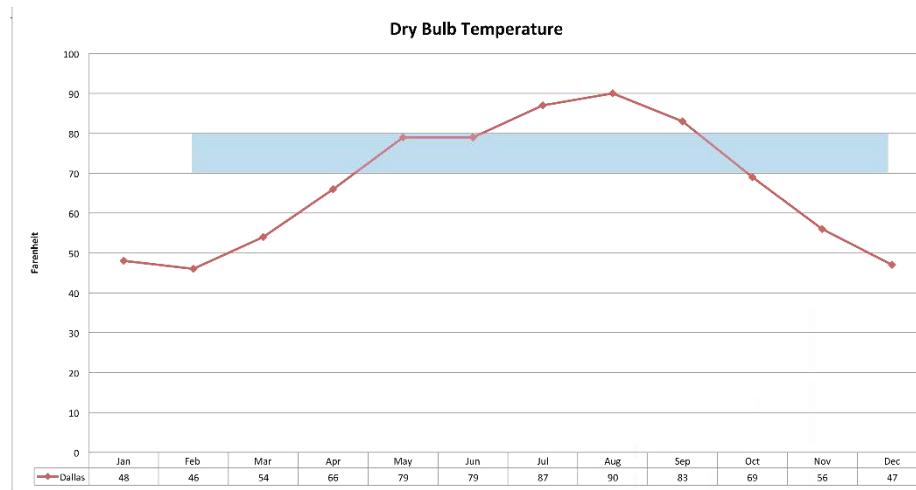


Fig 1: Dallas dry bulb temperature

Due to the high humidity, adaptive comfort ventilation is considered as one of the most effective design strategies in this area.

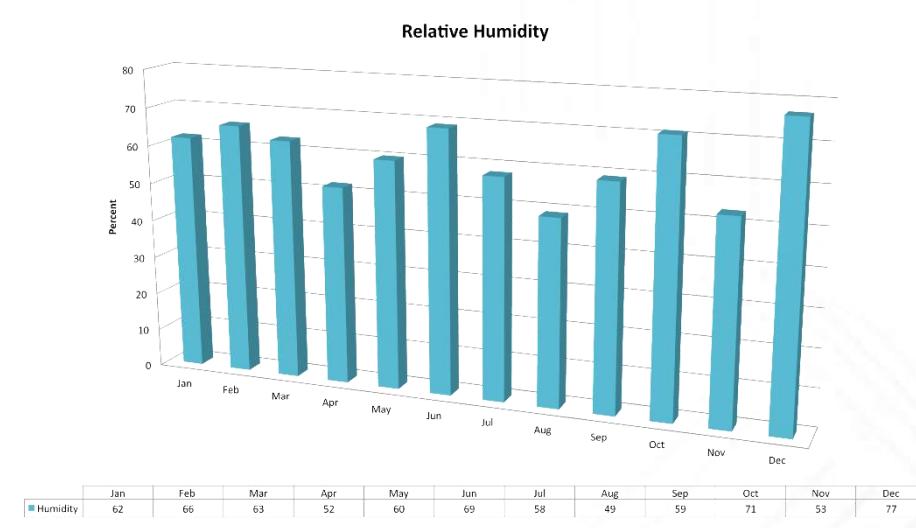


Fig 2: Dallas Relative humidity

Although the ground temperature seems to be mild and therefore reasonable to build a part of building in the ground, the high humidity, moisture and the possibility of mold, prevents us from constructing under the ground.

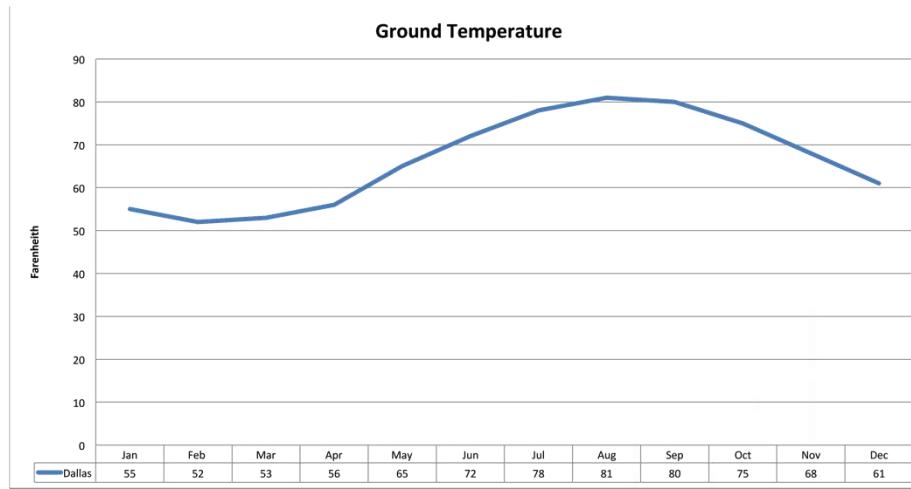


Fig 3: Dallas dry bulb temperature

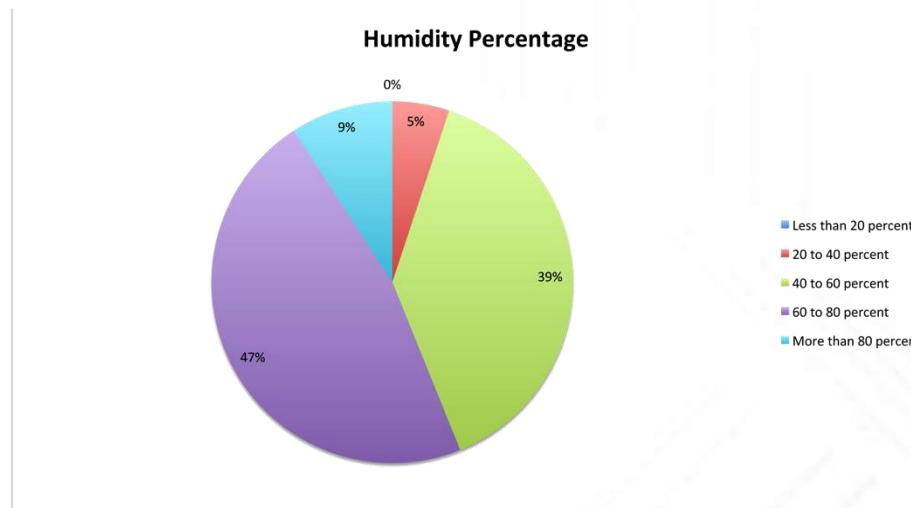


Fig 4: Dallas Relative humidity

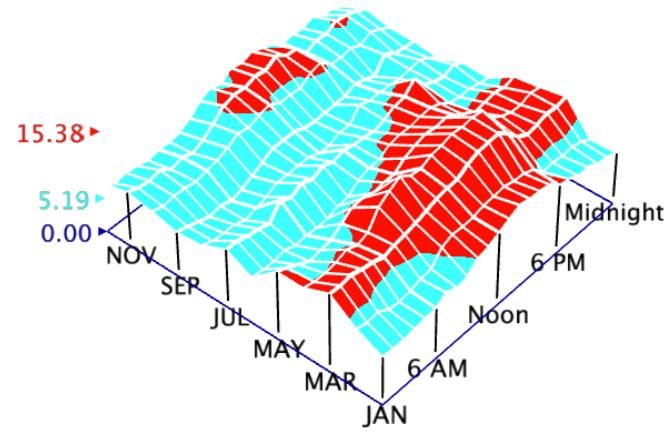


Fig 5: Wind Speed

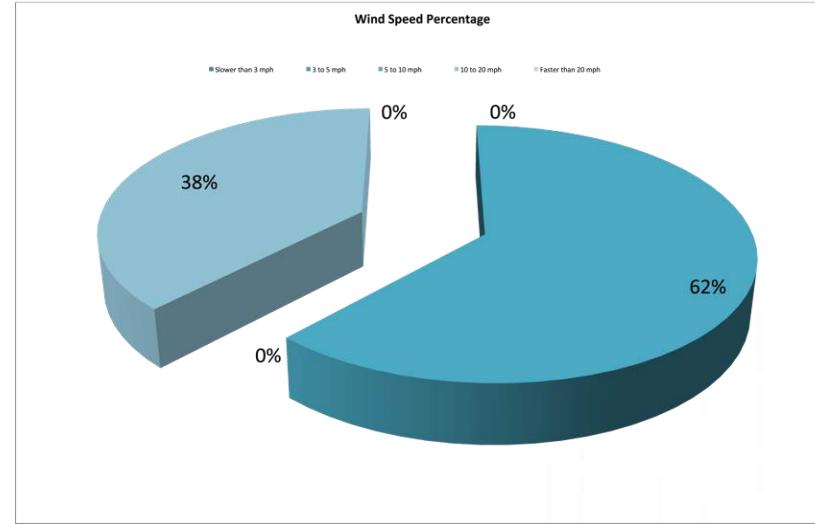


Fig 6: Wind speed percentage

The wind speed in this area is in a range(5-20 mph) where you can harvest the natural wind and use it as a leverage without any special or expensive financial investments.

Using natural ventilation in the buildings, as a response to the high humidity and high temperature, specially in summer, is crucial in this region.

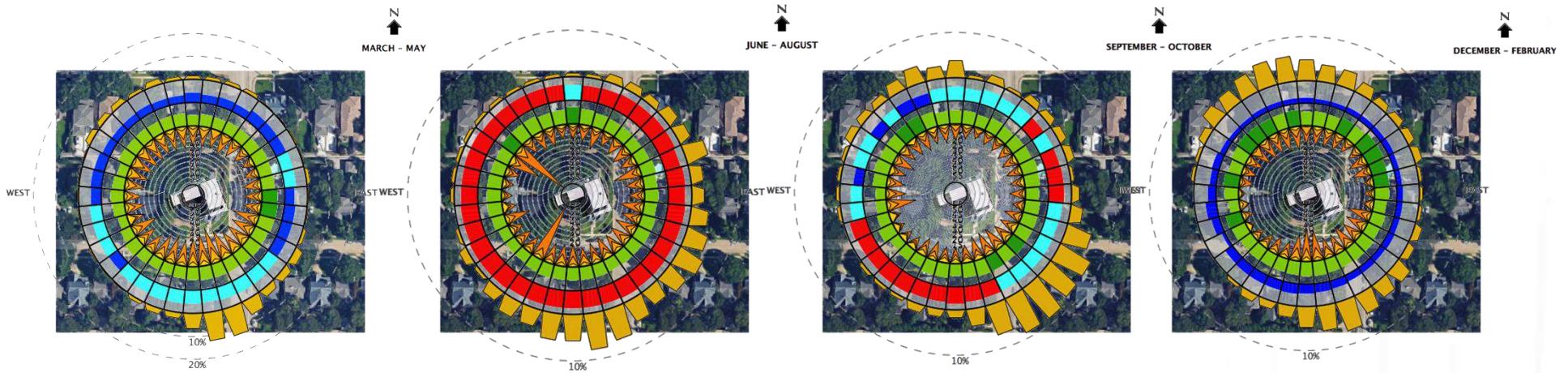
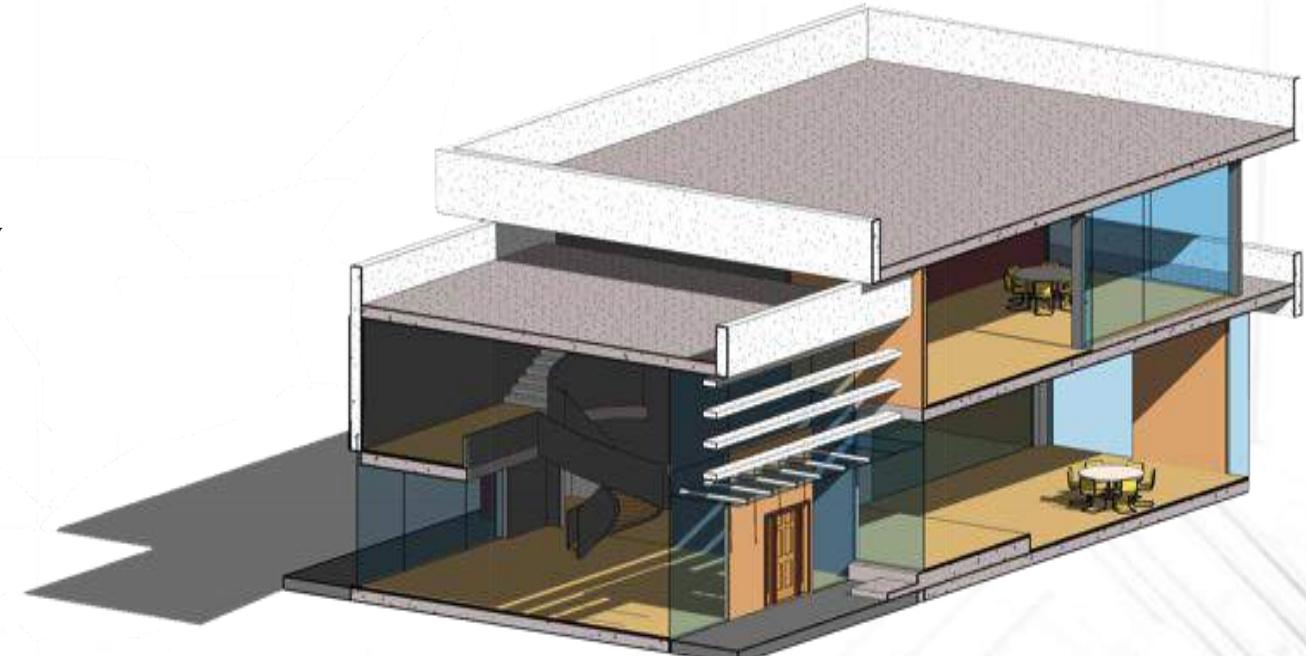


Fig 7: Wind rose pattern in Dallas through year

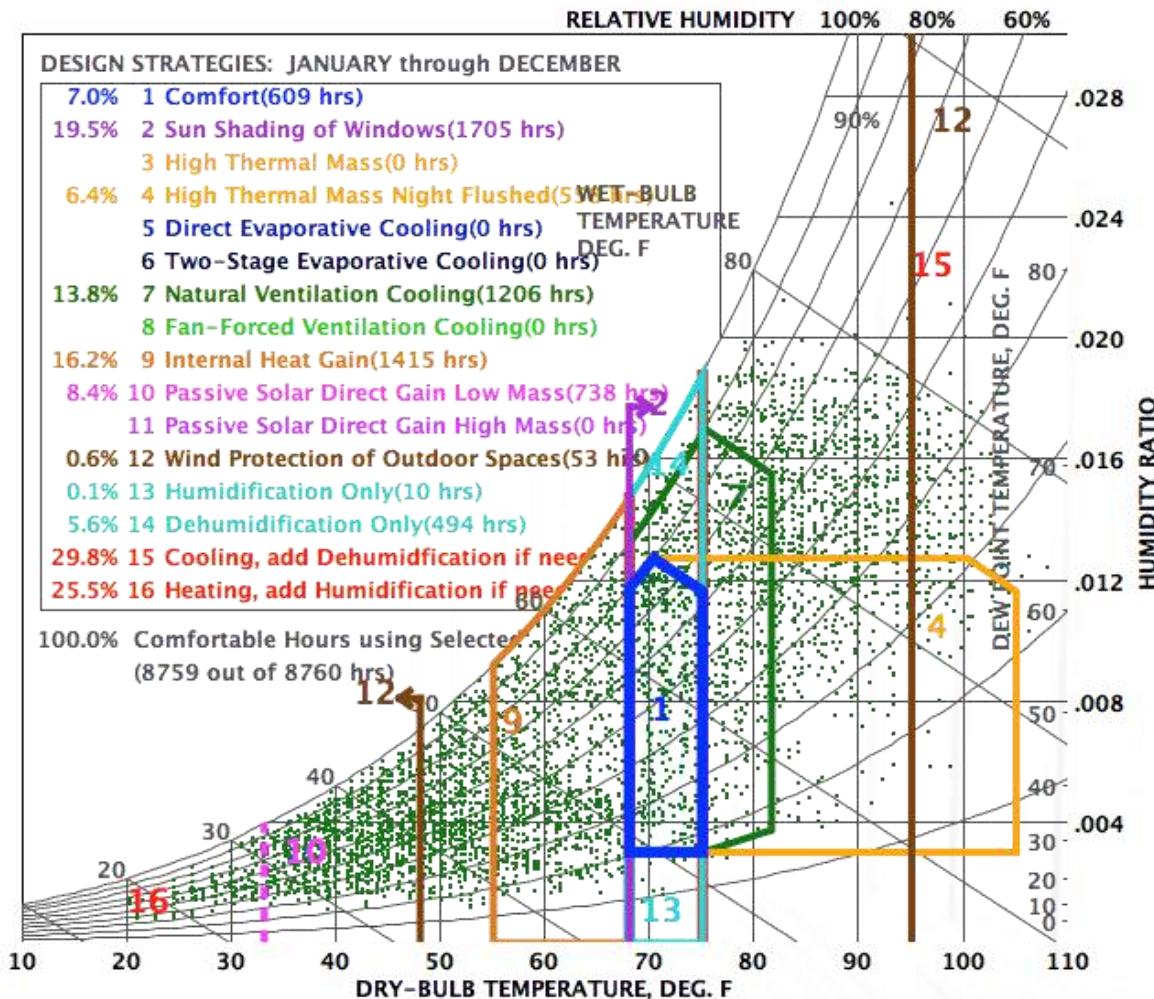
The majority of wind blows from north west and south east. since the climate of Dallas is warm and humid, it is necessary to keep the humidity under %65 and building dry in order to prevent mold.

The best way to achieve these goals is to create a natural ventilation by having openings in the wind direction



The Comfort Model used in this case study was the Adaptive Comfort model in ASHRAE Standard 55-2010. In naturally ventilated spaces where occupants can open and close windows, their thermal response will depend in part on the outdoor climate.

As shown in Fig 8, sun shading, dehumidification and natural ventilation cooling are some of the most important design strategies in this region.



For the purposes of rainfall reports data has been taken from :

<http://rainfall.weatherdb.com/l/244/Dallas-Texas>

While by average, 3.42

Inch per month rain has fallen in the last years, the mean of rainfall in year 2015 and to this date has been 4.93 inch per month which judging by the chart, can't be trusted as a generic rule to be concern.

The high and unexpected amount of rainfall in May 2015 is considered as noise and has no value in forecasting.

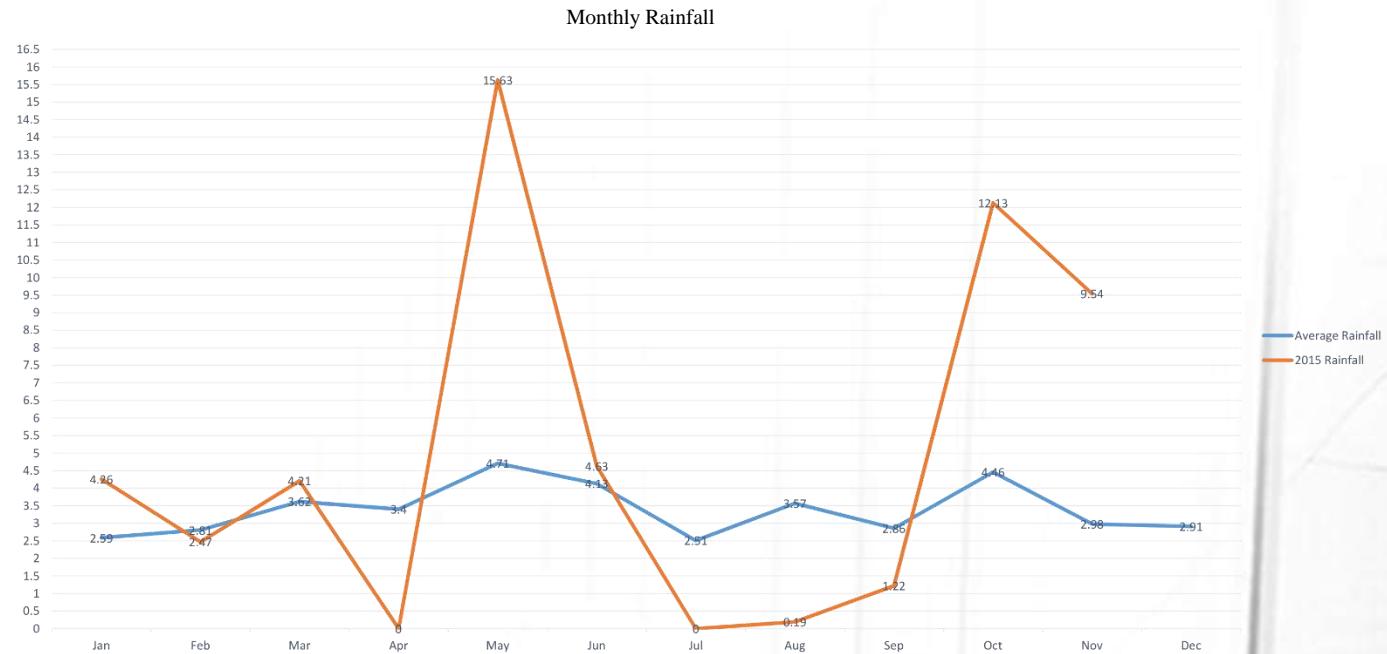


Fig 9: Dallas Monthly Rainfall Chart

- Dallas has an average rainfall of 40.55 inches over the last 30 years, which is about average nationwide(39.17 inches)
- This reported derived from NBC weather news report states that in only in December 2015, up until today there has been 4 flood warning in Dallas. Therefore one of the most recommended strategies in this region is to prevent building on land with the possibility of being flooded.
- The flood stage in Dallas is 30 feet

Here, in this map you can see the hotspots places, floodwise in Dallas, the site that we chose, is far enough to be considered safe

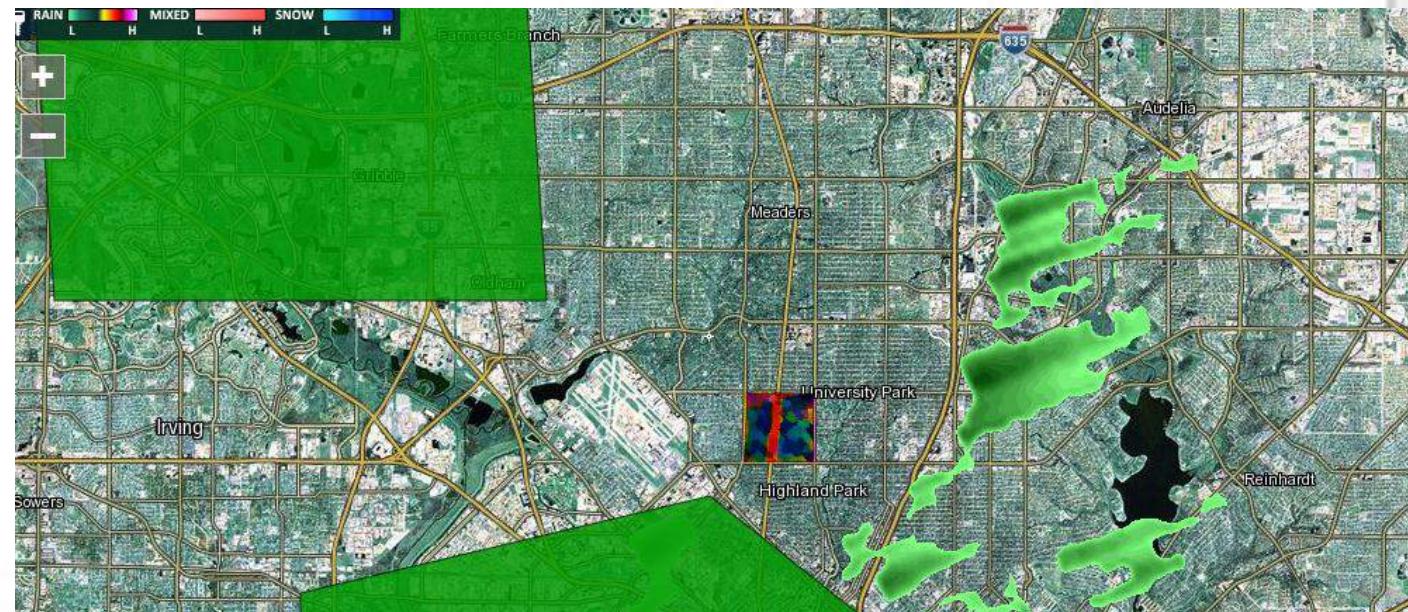


Fig 10: Flood Hotspot places in Dallas

CREDIT: INTEGRATIVE PROCESS

BD&C

1 point

This credit applies to

- New Construction
- Core & Shell
- Schools
- Retail
- Data Centers
- Warehouses & Distribution Centers
- Hospitality
- Healthcare

Intent

To support high-performance, cost-effective project outcomes through an early analysis of the interrelationships among systems.

Requirements

NC, CS, SCHOOLS, RETAIL, DATA CENTERS, WAREHOUSES & DISTRIBUTION CENTERS, HOSPITALITY, HEALTHCARE

Beginning in pre-design and continuing throughout the design phases, identify and use opportunities to achieve synergies across disciplines and building systems. Use the analyses described below to inform the owner's project requirements (OPR), basis of design (BOD), design documents, and construction documents.

Energy-Related Systems

Discovery: Perform a preliminary "simple box" energy modeling analysis before the completion of schematic design that explores how to reduce energy loads in the building and accomplish related sustainability goals by questioning default assumptions. Assess at least two potential strategies associated with the following:

- **Site conditions.** Assess shading, exterior lighting, hardscape, landscaping, and adjacent site conditions.
- **Massing and orientation.** Assess massing and orientation affect HVAC sizing, energy consumption, lighting, and renewable energy opportunities.
- **Basic envelope attributes.** Assess insulation values, window-to-wall ratios, glazing characteristics, shading, and window operability.
- **Lighting levels.** Assess interior surface reflectance values and lighting levels in occupied spaces.
- **Thermal comfort ranges.** Assess thermal comfort range options.
- **Plug and process load needs.** Assess reducing plug and process loads through programmatic solutions (e.g., equipment and purchasing policies, layout options).
- **Programmatic and operational parameters.** Assess multifunctioning spaces, operating schedules, space allotment per person, teleworking, reduction of building area, and anticipated operations and maintenance.

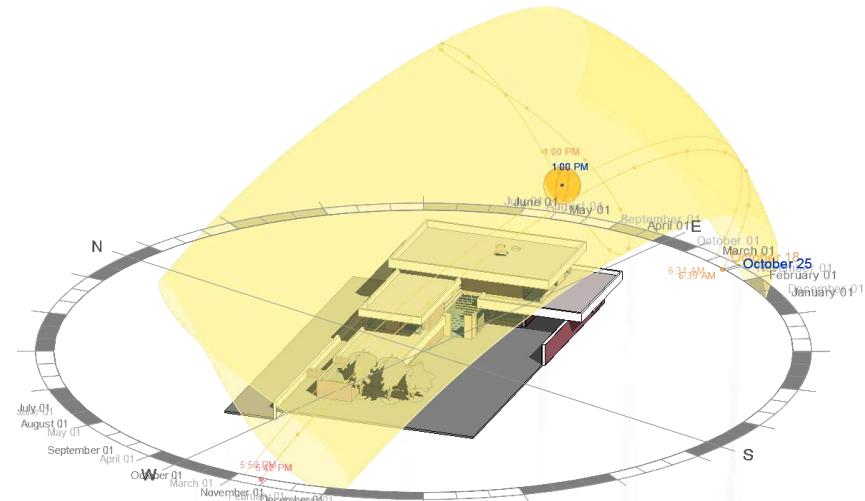


Fig 11: the residential orientation in favor of the sun path

The recommended strategies derived from the Green Building Adviser software judging by the given information from building are listed in appendix A. The strategies include a variety of context such as site & ecosystem, Energy use, Water use, Resource & materials and indoor Environments.

LT CREDIT: SENSITIVE LAND PROTECTION

BD&C

1-2 points

This credit applies to

- New Construction (1 point)
- Core & Shell (2 points)
- Schools (1 point)
- Retail (1 point)
- Data Centers (1 point)
- Warehouses & Distribution Centers (1 point)
- Hospitality (1 point)
- Healthcare (1 point)

Intent

To avoid the development of environmentally sensitive lands and reduce the environmental impact from the location of a building on a site.

Requirements

NC, CS, SCHOOLS, RETAIL, DATA CENTERS, WAREHOUSES & DISTRIBUTION CENTERS, HOSPITALITY, HEALTHCARE

Option 1.

Locate the development footprint on land that has been previously developed.

OR

Option 2.

Locate the development footprint on land that has been previously developed or that does not meet the following criteria for sensitive land:

- **Prime farmland.** Prime farmland, unique farmland, or farmland of statewide or local importance as defined by the U.S. Code of Federal Regulations, Title 7, Volume 6, Parts 400 to 699, Section 657.5 (or local equivalent for projects outside the U.S.) and identified in a state Natural Resources Conservation Service soil survey (or local equivalent for projects outside the U.S.).
- **Floodplains.** A flood hazard area shown on a legally adopted flood hazard map or otherwise legally designated by the local jurisdiction or the state. For projects in places without legally adopted flood hazard maps or legal designations, locate on a site that is entirely outside any floodplain subject to a 1% or greater chance of flooding in any given year.
- **Habitat.** Land identified as habitat for the following:
 - species listed as threatened or endangered under the U.S. Endangered Species Act or the state's endangered species act, or
 - species or ecological communities classified by NatureServe as GH (possibly extinct), G1 (critically imperiled), or G2 (imperiled), or
 - species listed as threatened or endangered species under local equivalent standards (for projects outside the U.S.) that are not covered by NatureServe data.
- **Water bodies.** Areas on or within 100 feet (30 meters) of a water body, except for minor improvements.
- **Wetlands.** Areas on or within 50 feet (15 meters) of a wetland, except for minor improvements.



Fig 12: A typical urban neighborhood, the site which the project is

The site of this project is in a typical neighborhood in Dallas with more than 20 year residential background, therefore the land is considered as previously developed and not a farmland.

LT CREDIT: SURROUNDING DENSITY AND DIVERSE USES

BD&C

1–6 points

This credit applies to

- New Construction (1–5 points)
- Core & Shell (1–6 points)
- Schools (1–5 points)
- Retail (1–5 points)
- Data Centers (1–5 points)
- Warehouses & Distribution Centers (1–5 points)
- Hospitality (1–5 points)
- Healthcare (1 points)

Intent

To conserve land and protect farmland and wildlife habitat by encouraging development in areas with existing infrastructure. To promote walkability, and transportation efficiency and reduce vehicle distance traveled. To improve public health by encouraging daily physical activity.

Requirements

NC, CS, SCHOOLS, RETAIL, DATA CENTERS, HOSPITALITY

Option 1. Surrounding Density (2–3 points BD&C except Core and Shell, 2–4 points Core and Shell)

Locate on a site whose surrounding existing density within a ¼-mile (400-meter) radius of the project boundary meets the values in Table 1. Use either the "separate residential and nonresidential densities" or the "combined density" values.

Table 1a. Points for average density within 1/4 mile of project (IP units)

| Combined density | Separate residential and nonresidential densities | | Points BD&C (except Core and Shell) | Points BD&C (Core and Shell) |
|--|---|------------------------------|-------------------------------------|------------------------------|
| Square feet per acre of buildable land | Residential density (DU/acre) | Nonresidential density (FAR) | | |
| 22,000 | 7 | 0.5 | 2 | 2 |
| 35,000 | 12 | 0.8 | 3 | 4 |

Option 2. Diverse Uses (1–2 points)

Construct or renovate a building or a space within a building such that the building's main entrance is within a ½-mile (800-meter) walking distance of the main entrance of four to seven (1 point) or eight or more (2 points) existing and publicly available diverse uses (listed in Appendix 1).

The following restrictions apply.

- A use counts as only one type (e.g., a retail store may be counted only once even if it sells products in several categories).
- No more than two uses in each use type may be counted (e.g. if five restaurants are within walking distance, only two may be counted).
- The counted uses must represent at least three of the five categories, exclusive of the building's primary use.

APPENDICES

APPENDIX 1. USE TYPES AND CATEGORIES

Table 1. Use Types and Categories

| Category | Use type |
|--|---|
| Food retail | Supermarket Grocery with produce section |
| Community-serving retail | Convenience store Farmers market Hardware store Pharmacy Other retail |
| Services | Bank Family entertainment venue (e.g., theater, sports) Gym, health club, exercise studio Hair care Laundry, dry cleaner Restaurant, café, diner (excluding those with only drive-thru service) |
| Civic and community facilities | Adult or senior care (licensed) Child care (licensed) Community or recreation center Cultural arts facility (museum, performing arts) Education facility (e.g., K–12 school, university, adult education center, vocational school, community college) Government office that serves public on-site Medical clinic or office that treats patients Place of worship Police or fire station Post office Public library Public park Social services center |
| Community anchor uses (BD&C and ID&C only) | Commercial office (100 or more full-time equivalent jobs) Housing (100 or more dwelling units) |



Fig 13: The map of public stores and places to the residential and their approximate distance to the residential

The house is built in a neighborhood with an existing infrastructures where the convenience locations(i.e. supermarket, grocery store, coffee shop and etc.) are reachable with a walking distance, thus eliminating the need of using vehicles in order to reach them, which results in conserving the farmlands, reducing vehicle travels and promoting walkability.

LT CREDIT: ACCESS TO QUALITY TRANSIT

BD&C

1–6 points

This credit applies to

- New Construction (1–5 points)
- Core & Shell (1–6 points)
- Schools (1–4 points)
- Data Centers (1–5 points)
- Warehouses & Distribution Centers (1–5 points)
- Hospitality (1–5 points)
- Retail (1–5 points)
- Healthcare (1–2 points)

Intent

To encourage development in locations shown to have **multimodal transportation choices** or otherwise **reduced motor vehicle use**, thereby reducing greenhouse gas emissions, air pollution, and other environmental and public health harms associated with motor vehicle use.

Requirements

NC, CS, DATA CENTERS, WAREHOUSES & DISTRIBUTION CENTERS, HOSPITALITY, RETAIL

Locate any *functional entry* of the project within a $\frac{1}{4}$ -mile (400-meter) *walking distance* of existing or planned bus, streetcar, or rideshare stops, or within a $\frac{1}{2}$ -mile (800-meter) walking distance of existing or planned bus rapid transit stops, light or heavy rail stations, commuter rail stations, or commuter ferry terminals.

Both weekday and weekend trip minimums must be met.

- Qualifying transit routes must have paired route service (service in opposite directions).
- For each qualifying transit route, only trips in one direction are counted towards the threshold.
- If a qualifying transit route has multiple stops within the required walking distance, only trips from one stop are counted towards the threshold.

Table 1. Minimum daily transit service for projects with multiple transit types (bus, streetcar, rail, or ferry)

| Weekday trips | Weekend trips | Points BD&C (except Core and Shell) | Points BD&C (Core and shell) |
|---------------|---------------|-------------------------------------|------------------------------|
| 72 | 40 | 1 | 1 |
| 144 | 108 | 3 | 3 |
| 360 | 216 | 5 | 6 |

Table 2. Minimum daily transit service for projects with commuter rail or ferry service only

| Weekday trips | Weekend trips | Points |
|---------------|---------------|--------|
| 24 | 6 | 1 |
| 40 | 8 | 2 |

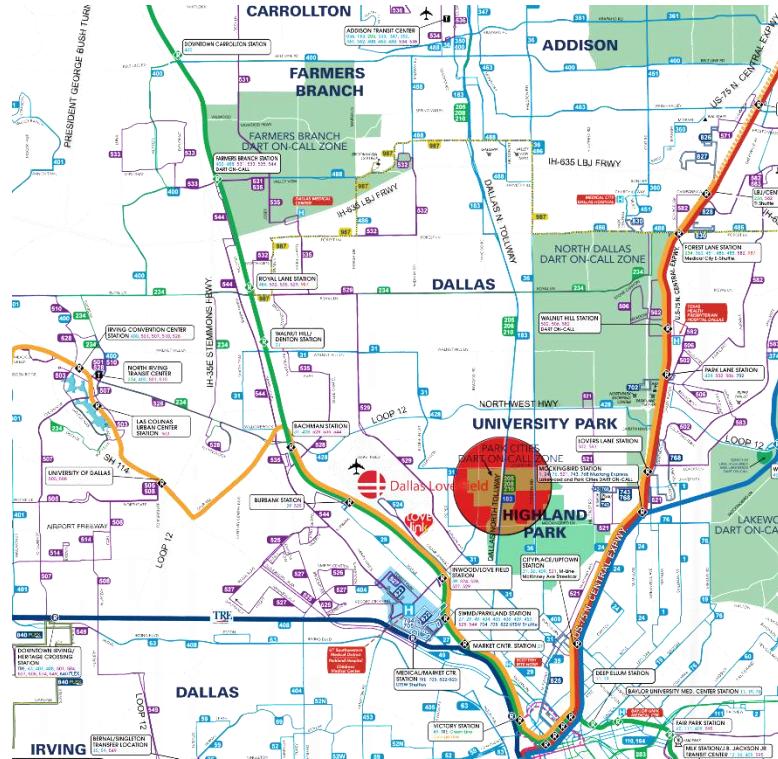


Fig 14: The public transportation map in Dallas

The neighborhood location, as you can see, is near the public transportation route (blue line), which results in the reduction of motor vehicle use by the residents in this neighborhood and ultimately, it helps with the greenhouse gas emissions.

LT CREDIT: BICYCLE FACILITIES

BD&C
1 point

This credit applies to:

- New Construction (1 point)
- Core & Shell (1 point)
- Schools (1 point)
- Data Centers (1 point)
- Warehouses & Distribution Centers (1 point)
- Hospitality (1 point)
- Retail (1 point)
- Healthcare (1 point)

Intent

To promote bicycling and transportation efficiency and reduce vehicle distance traveled. To improve public health by encouraging utilitarian and recreational physical activity.

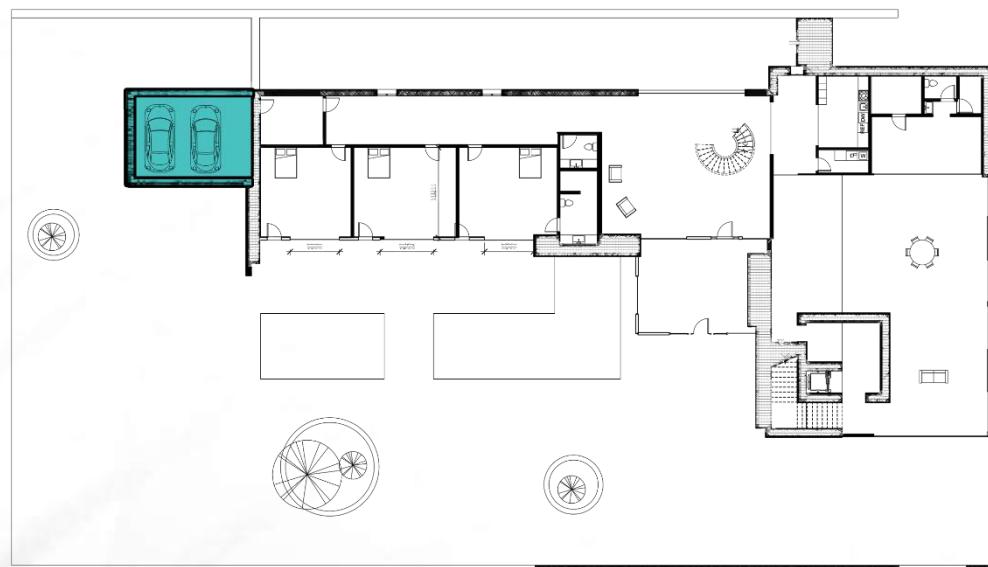
Case 2. Residential Projects

Provide short-term bicycle storage for at least 2.5% of all peak visitors but no fewer than four storage spaces per building.

Provide long-term bicycle storage for at least 30% of all regular building occupants, but no less than one storage space per residential unit.

For All Projects

Short-term bicycle storage must be within 100 feet (30 meters) walking distance of any main entrance.
Long-term bicycle storage must be within 100 feet (30 meters) walking distance of any functional entry.



There is a bicycle storage provided in the garage, with a less than 100 feet distance to the main entrance.

LT CREDIT: REDUCED PARKING FOOTPRINT

BD&C

1 point

This credit applies to

- New Construction (1 point)
- Core & Shell (1 point)
- Schools (1 point)
- Data Centers (1 point)
- Warehouses & Distribution Centers (1 point)
- Hospitality (1 point)
- Retail (1 point)
- Healthcare (1 point)

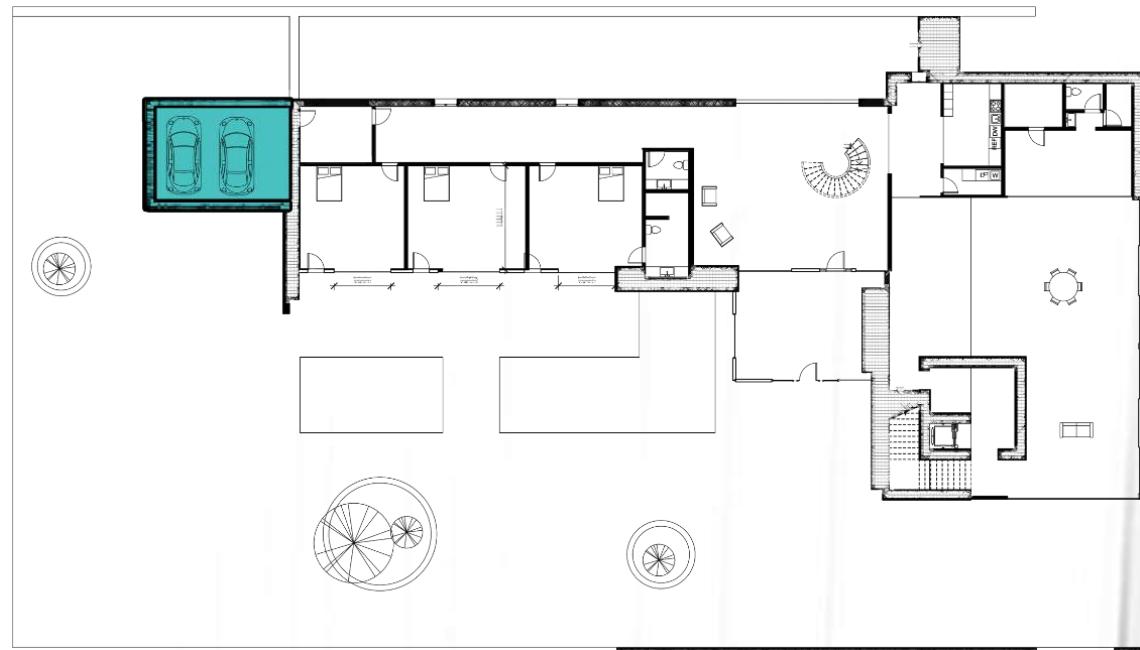
Intent

To minimize the environmental harms associated with parking facilities, including automobile dependence, land consumption, and rainwater runoff.

Requirements

NC, CS, RETAIL, SCHOOLS, DATA CENTERS, WAREHOUSES & DISTRIBUTION CENTERS, HOSPITALITY, HEALTHCARE

Do not exceed the minimum local code requirements for parking capacity.



The parking requirement (see appendix C) clearly states the need of two spaces of parking for each residential with three or more bedroom. A local code which has not been exceeded in this building.

LT CREDIT: GREEN VEHICLES

BD&C

1 point

This credit applies to

- New Construction (1 point)
- Core & Shell (1 point)
- Data Centers (1 point)
- Hospitality (1 point)
- Retail (1 point)
- Healthcare (1 point)
- Schools (1 point)
- Warehouses & Distribution Centers (1 point)

Intent

To reduce pollution by promoting alternatives to conventionally fueled automobiles.

Option 1. Electric Vehicle Charging

Install **electrical vehicle supply equipment** (EVSE) in 2% of all parking spaces used by the project. Clearly identify and reserve these spaces for the sole use by plug-in electric vehicles. EVSE parking spaces must be provided in addition to preferred parking spaces for green vehicles.

The EVSE must:

- Provide a Level 2 charging capacity (208 – 240 volts) or greater.
- Comply with the relevant regional or local standard for electrical connectors, such as SAE Surface Vehicle Recommended Practice J1772, SAE Electric Vehicle Conductive Charge Coupler or IEC 62196 of the International Electrotechnical Commission for projects outside the U.S.
- Be networked or internet addressable and be capable of participating in a demand-response program or time-of-use pricing to encourage off-peak charging.

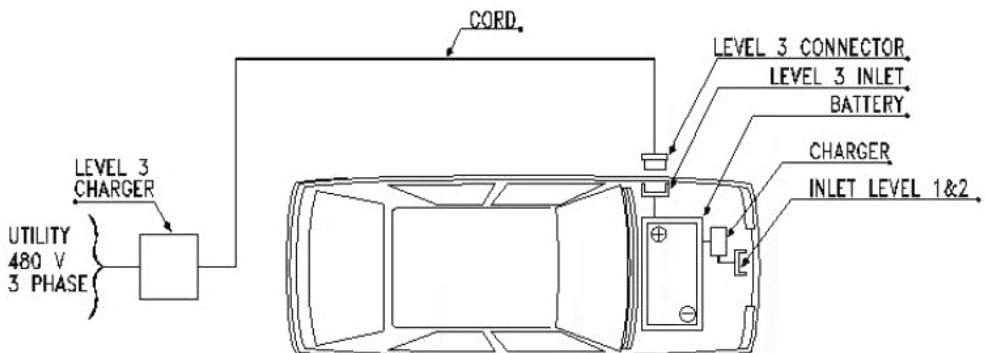
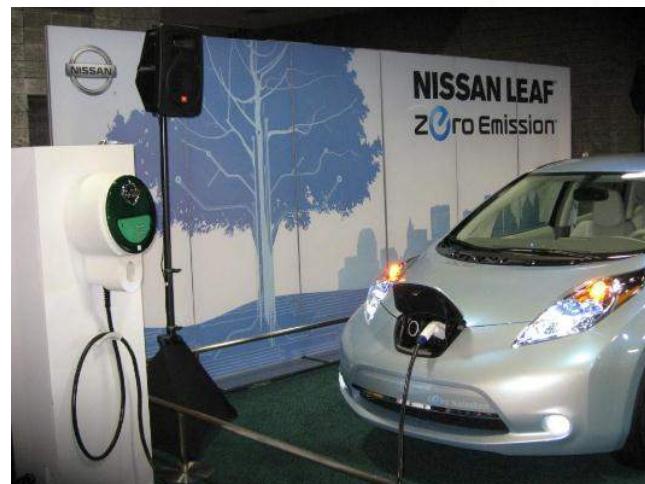


Fig 15: EVSE



SS CREDIT: SITE ASSESSMENT

BD&C

1 point

This credit applies to

- New Construction (1 point)
- Core & Shell (1 point)
- Schools (1 point)
- Retail (1 point)
- Data Centers (1 point)
- Warehouses & Distribution Centers (1 point)
- Hospitality (1 point)
- Healthcare (1 point)

Intent

To assess site conditions before design to evaluate sustainable options and inform related decisions about site design.

Requirements

NC, CS, SCHOOLS, RETAIL, DATA CENTERS, WAREHOUSES & DISTRIBUTION CENTERS, HOSPITALITY, HEALTHCARE

Complete and document a site survey or assessment¹ that includes the following information:

- *Topography*. Contour mapping, unique topographic features, slope stability risks.
- *Hydrology*. Flood hazard areas, delineated wetlands, lakes, streams, shorelines, rainwater collection and reuse opportunities, TR-55 initial water storage capacity of the site (or local equivalent for projects outside the U.S.).
- *Climate*. Solar exposure, heat island effect potential, seasonal sun angles, prevailing winds, monthly precipitation and temperature ranges.
- *Vegetation*. Primary vegetation types, greenfield area, significant tree mapping, threatened or endangered species, unique habitat, invasive plant species.
- *Soils*. Natural Resources Conservation Service soils delineation, U.S. Department of Agriculture prime farmland, healthy soils, previous development, disturbed soils (local equivalent standards may be used for projects outside the U.S.).
- *Human use*. Views, adjacent transportation infrastructure, adjacent properties, construction materials with existing recycle or reuse potential.
- *Human health effects*. Proximity of vulnerable populations, adjacent physical activity opportunities, proximity to major sources of air pollution.

Different considerations such as studying climate conditions (See the climate consultant part) has been put in motion before designing this residential.

SS CREDIT: SITE DEVELOPMENT—PROTECT OR RESTORE HABITAT

BD&C

1–2 points

This credit applies to

- New Construction (1–2 points)
- Core & Shell (1–2 points)
- Schools (1–2 points)
- Retail (1–2 points)
- Data Centers (1–2 points)
- Warehouses & Distribution Centers (1–2 points)
- Hospitality (1–2 points)
- Healthcare (1 point)

Intent

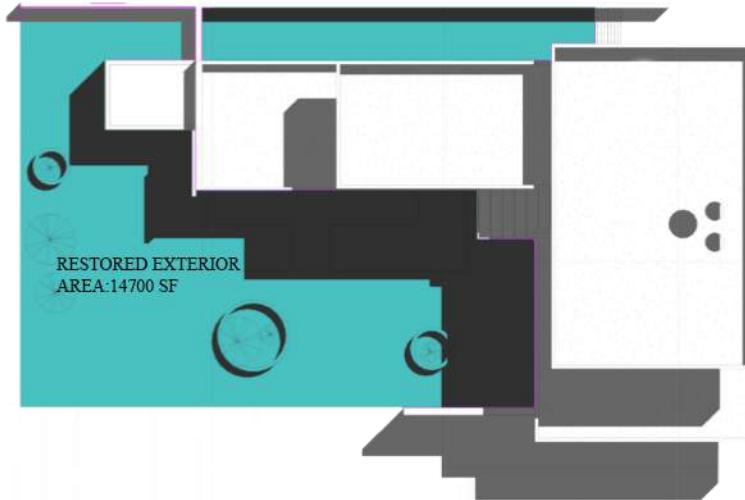
To conserve existing natural areas and restore damaged areas to provide habitat and promote biodiversity.

Option 1. On-Site Restoration (2 points except Healthcare, 1 point Healthcare)

Using native or adapted vegetation, restore 30% (including the building footprint) of all portions of the site identified as previously disturbed. Projects that achieve a density of 1.5 floor-area ratio may include vegetated roof surfaces in this calculation if the plants are native or adapted, provide habitat, and promote biodiversity.

Restore all disturbed or compacted soils that will be revegetated within the project's development footprint to meet the following requirements²:

- Soils (imported and in situ) must be reused for functions comparable to their original function.
- Imported topsoils or soil blends designed to serve as topsoil may not include the following:
 - soils defined regionally by the Natural Resources Conservation Service web soil survey (or local equivalent for projects outside the U.S.) as prime farmland, unique farmland, or farmland of statewide or local importance; or
 - soils from other greenfield sites, unless those soils are a byproduct of a construction process.
- Restored soil must meet the criteria of *reference soils* in categories 1–3 and meet the criteria of either category 4 or 5:
 1. organic matter;
 2. compaction;
 3. infiltration rates;
 4. soil biological function; and
 5. soil chemical characteristics.



$$14700/22300=65.9\%$$

As you can see here 65.9 % of the total site is considered as open space, where this number for the previous building in this exact site was only 12%.

SS CREDIT: OPEN SPACE

BD&C

1 point

This credit applies to

- New Construction (1 point)
- Core & Shell (1 point)
- Schools (1 point)
- Retail (1 point)
- Data Centers (1 point)
- Warehouses & Distribution Centers (1 point)
- Hospitality (1 point)
- Healthcare (1 point)

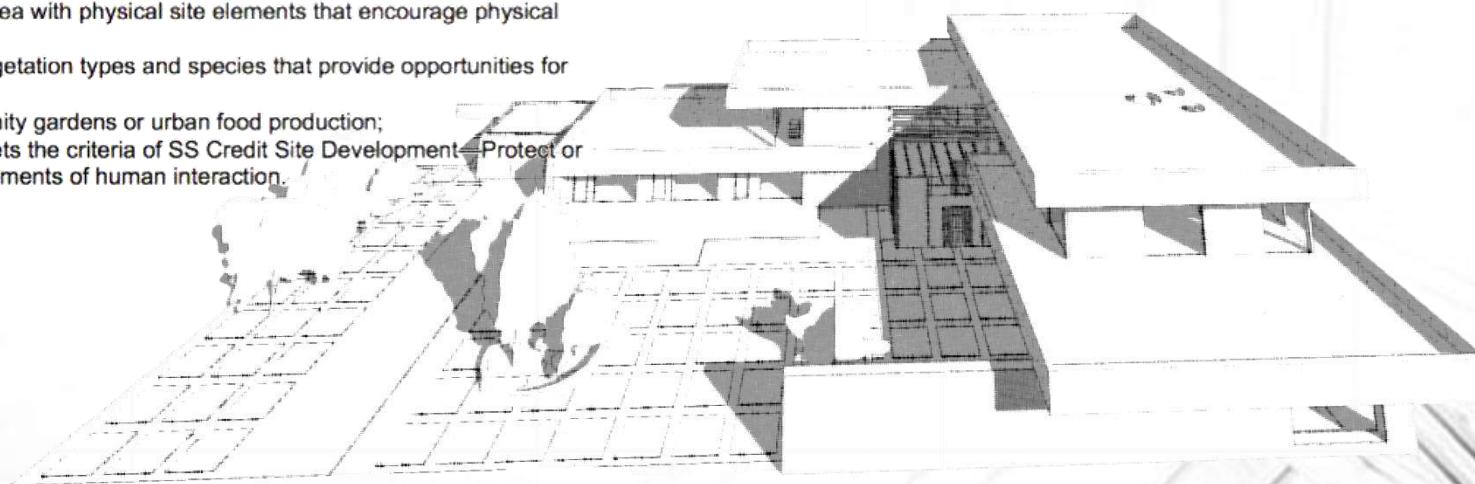
Intent

To create exterior open space that encourages interaction with the environment, social interaction, passive recreation, and physical activities.

Provide outdoor space greater than or equal to 30% of the total site area (including building footprint). A minimum of 25% of that outdoor space must be vegetated (turf grass does not count as vegetation) or have overhead vegetated canopy.

The outdoor space must be physically accessible and be one or more of the following:

- a pedestrian-oriented paving or turf area with physical site elements that accommodate outdoor social activities;
- a recreation-oriented paving or turf area with physical site elements that encourage physical activity;
- a garden space with a diversity of vegetation types and species that provide opportunities for year-round visual interest;
- a garden space dedicated to community gardens or urban food production;
- preserved or created habitat that meets the criteria of SS Credit Site Development—Protect or Restore Habitat and also includes elements of human interaction.



SS CREDIT: HEAT ISLAND REDUCTION

BD&C

1–2 points

This credit applies to

- New Construction (1-2 points)
- Core & Shell (1-2 points)
- Schools (1-2 points)
- Retail (1-2 points)
- Data Centers (1-2 points)
- Warehouses & Distribution Centers (1-2 points)
- Hospitality (1-2 points)
- Healthcare (1 point)

Intent

To minimize effects on microclimates and human and wildlife habitats by reducing heat islands.

Nonroof Measures

- Use the existing plant material or install plants that provide shade over paving areas (including playgrounds) on the site within 10 years of planting. Install vegetated planters. Plants must be in place at the time of occupancy permit and cannot include artificial turf.
- Provide shade with structures covered by energy generation systems, such as solar thermal collectors, photovoltaics, and wind turbines.
- Provide shade with architectural devices or structures that have a three-year aged solar reflectance (SR) value of at least 0.28. If three-year aged value information is not available, use materials with an initial SR of at least 0.33 at installation.
- Provide shade with vegetated structures.
- Use paving materials with a three-year aged solar reflectance (SR) value of at least 0.28. If three-year aged value information is not available, use materials with an initial SR of at least 0.33 at installation.
- Use an open-grid pavement system (at least 50% unbound).

Because to the overhangs which are designed all around the envelope, covering each window and storefront, not only a proper shade and temperature decrease would be provided for the residents, but also problematic light and glares won't be an issue anymore

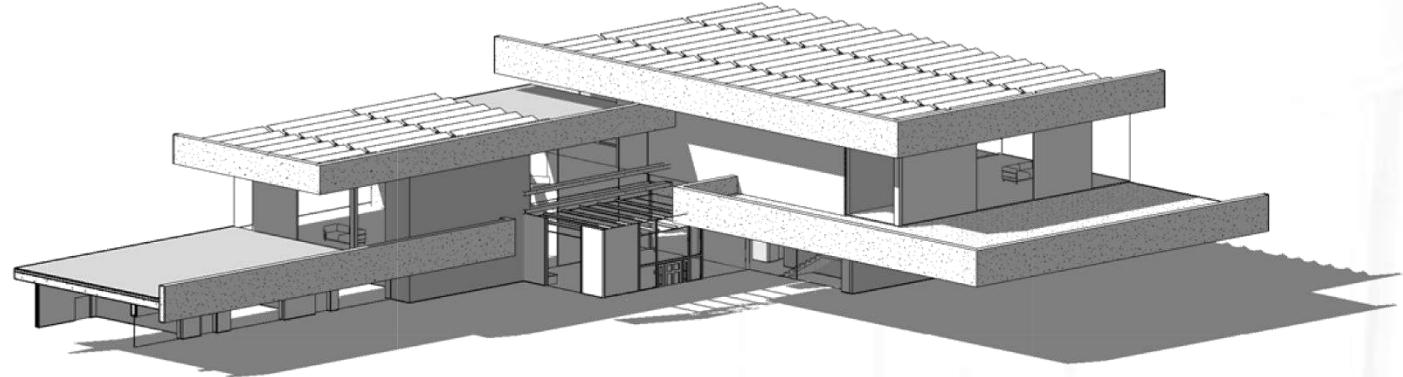
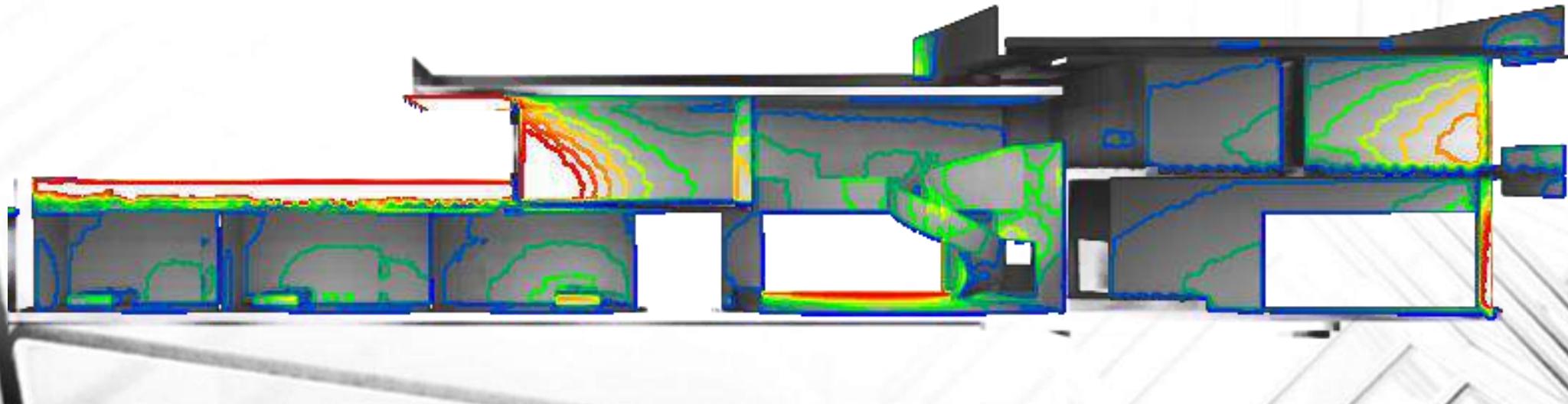


Fig 16: Deep overhangs, causing appropriate amount on the envelope



Minimum solar reflectance index value, by roof slope

| | Slope | Initial SRI | 3-year aged SRI |
|-------------------|-------------|-------------|-----------------|
| Low-sloped roof | $\leq 2:12$ | 82 | 64 |
| Steep-sloped roof | $> 2:12$ | 39 | 32 |

The higher SRI for the roofs, the less heat gain.
Therefore the roof pavement is in light color.
It is important to mention that main parts of the roof is equipped with PV solar panels which act as barriers and prevent the heat gain.

| Material surface | Solar Reflectance* | Emittance | SRI* |
|------------------------------------|--------------------|-----------|-----------|
| Black acrylic paint | 0.05 | 0.9 | 0 |
| New asphalt | 0.05 | 0.9 | 0 |
| Aged asphalt | 0.1 | 0.9 | 6 |
| "White" asphalt shingle | 0.21 | 0.91 | 21 |
| Aged concrete | 0.2 to 0.3 | 0.9 | 19 to 32 |
| New concrete (ordinary) | 0.35 to 0.45 | 0.9 | 38 to 52 |
| New white portland cement concrete | 0.7 to 0.8 | 0.9 | 86 to 100 |
| White acrylic paint | 0.8 | 0.9 | 100 |

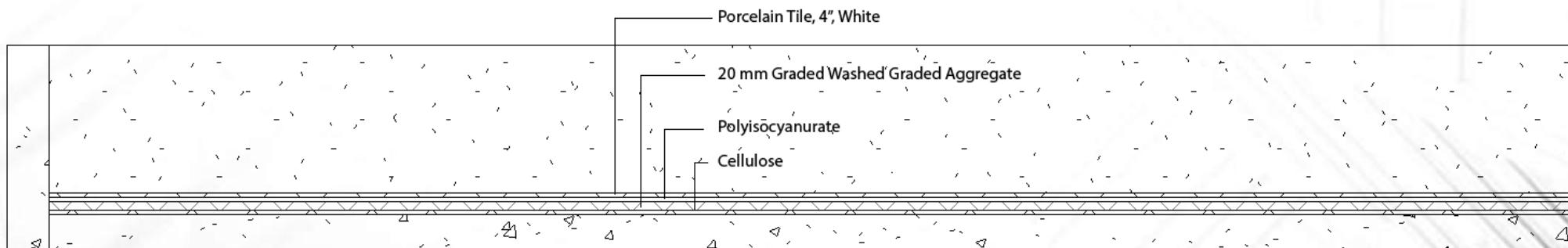


Fig 17: Roof Section

While asphalt and concrete have been the go-to outdoor surfaces for years, they really have very few benefits other than being one of the least expensive options. A better choice would be a pervious material — something that allows water to drain through the material itself, or through the joints of the construction (Fig 19).

By allowing water to filtrate into the ground, the surface and surrounding area temperatures will be cooler than a hard impervious surface. Bonus points for using permeable surfaces that are also light in color, because they will also help reflect sun and heat to even further reduce the local ambient temperature, which will also improve the health of local vegetation and improves air quality.



Fig 18: Open grid pavement system used in the project

WE CREDIT: OUTDOOR WATER USE REDUCTION

BD&C

1–2 points

This credit applies to

- New Construction (1–2 points)
- Core & Shell (1–2 points)
- Schools (1–2 points)
- Retail (1–2 points)
- Data Centers (1–2 points)
- Warehouses & Distribution Centers (1–2 points)
- Hospitality (1–2 points)
- Healthcare (1 point)

Intent

To reduce outdoor water consumption.

NC, CS, SCHOOLS, RETAIL, DATA CENTERS, WAREHOUSES & DISTRIBUTION CENTERS, HOSPITALITY, HEALTHCARE

Reduce outdoor water use through one of the following options. Nonvegetated surfaces, such as permeable or impermeable pavement, should be excluded from landscape area calculations. Athletic fields and playgrounds (if vegetated) and food gardens may be included or excluded at the project team's discretion.

Option 1. No Irrigation Required (2 points except Healthcare, 1 point Healthcare)

Show that the landscape does not require a permanent irrigation system beyond a maximum two-year establishment period.

Permeable paving is a range of sustainable materials and techniques for permeable pavements with a base and sub-base that allow the movement of storm water through the surface. In addition to reducing runoff, this effectively traps suspended solids and filters pollutants from the water.

By allowing the water to seep into the ground, the direct and surrounding areas will need much less man-produced irrigation. This will save you money and reduce the amount of water used for your everyday irrigation needs.

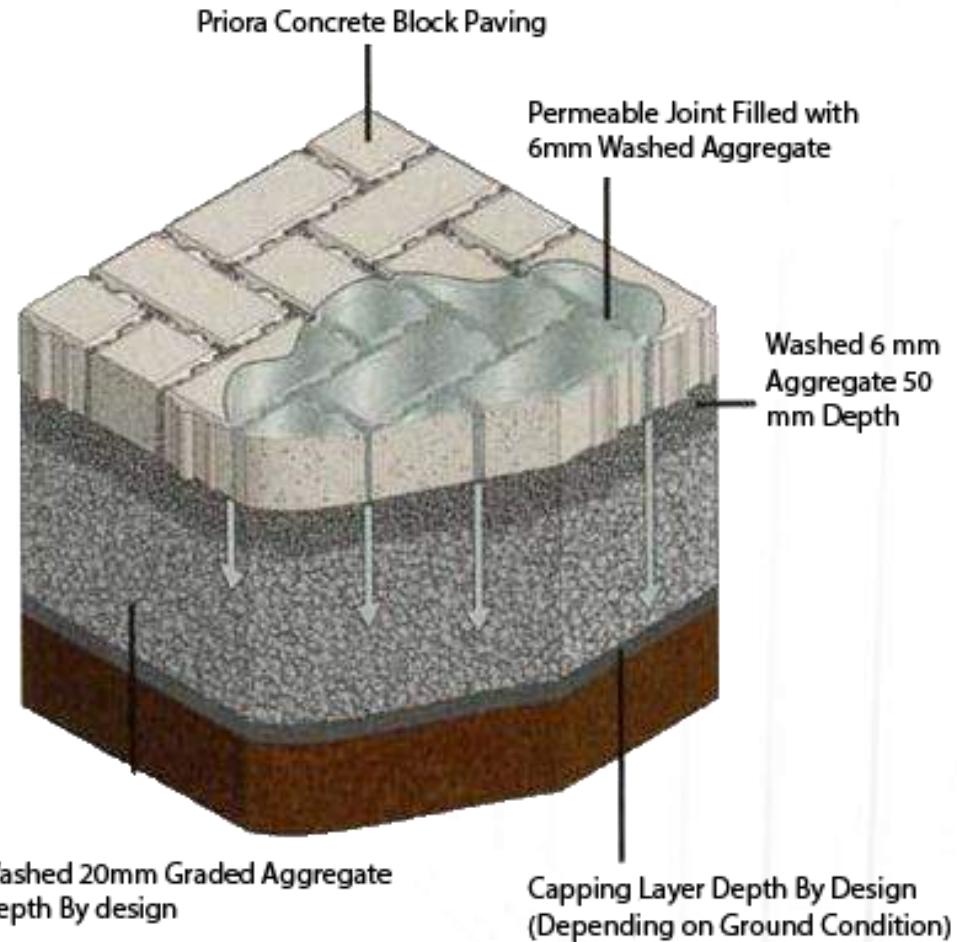


Fig 19: Permeable Paving system

WE CREDIT: INDOOR WATER USE REDUCTION

BD&C

1–7 points

This credit applies to

- New Construction (1–6 points)
- Core & Shell (1–6 points)
- Schools (1–7 points)
- Retail (1–7 points)
- Data Centers (1–6 points)
- Warehouses & Distribution Centers (1–6 points)
- Hospitality (1–6 points)
- Healthcare (1–7 points)

Intent

To reduce indoor water consumption.

Further reduce fixture and fitting water use from the calculated baseline in WE Prerequisite Indoor Water Use Reduction. Additional potable water savings can be earned above the prerequisite level using alternative water sources. Include fixtures and fittings necessary to meet the needs of the occupants. Some of these fittings and fixtures may be outside the tenant space (for Commercial Interiors) or project boundary (for New Construction). Points are awarded according to Table 1.

Table 1. Points for reducing water use

| Percentage reduction | Points (BD&C) | Points (Schools, Retail, Hospitality, Healthcare) |
|----------------------|---------------|---|
| 25% | 1 | 1 |
| 30% | 2 | 2 |
| 35% | 3 | 3 |
| 40% | 4 | 4 |
| 45% | 5 | 5 |
| 50% | 6 | -- |

Table 2. Compliant commercial washing machines

To use Table 2, the project must process at least 120,000 lbs (57 606 kg) of laundry per year.

| Washing machine | Requirement (IP units) | Requirement (SI units) |
|--|------------------------------|---------------------------------------|
| On-premise, minimum capacity 2,400 lbs (1 088 kg) per 8-hour shift | Maximum 1.8 gals per pound * | Maximum 7 liters per 0.45 kilograms * |

* Based on equal quantities of heavy, medium, and light soil laundry.

Table 3. Standards for commercial kitchen equipment

To use Table 3, the project must serve at least 100 meals per day of operation. All process and appliance equipment listed in the category of kitchen equipment and present on the project must comply with the standards.

| <i>Kitchen equipment</i> | | <i>Requirement (IP units)</i> | <i>Requirement (SI units)</i> |
|--------------------------|---------------------------------------|--|---|
| Dishwasher | Undercounter | ENERGY STAR | ENERGY STAR or performance equivalent |
| | Stationary, single tank, door | ENERGY STAR | ENERGY STAR or performance equivalent |
| | Single tank, conveyor | ENERGY STAR | ENERGY STAR or performance equivalent |
| | Multiple tank, conveyor | ENERGY STAR | ENERGY STAR or performance equivalent |
| | Flight machine | ENERGY STAR | ENERGY STAR or performance equivalent |
| Food steamer | Batch (no drain connection) | ≤ 2 gal/hour/pan including condensate cooling water | ≤ 7.5 liters/hour/pan including condensate cooling water |
| | Cook-to-order (with drain connection) | ≤ 5 gal/hour/pan including condensate cooling water | ≤ 19 liters/hour/pan including condensate cooling water |
| Combination oven, | Countertop or stand | ≤ 1.5 gal/hour/pan including condensate cooling water | ≤ 5.7 liters/hour/pan including condensate cooling water |
| Food waste disposer | Disposer | 3-8 gpm, full load condition, 10-minute automatic shutoff; or 1 gpm, no-load condition | 11–30 lpm, full load condition, 10-min automatic shutoff; or 3.8 lpm, no-load condition |
| | Scrap collector | Maximum 2 gpm makeup water | Maximum 7.6 lpm makeup water |
| | Pulper | Maximum 2 gpm makeup water | Maximum 7.6 lpm makeup water |
| | Strainer basket | No additional water usage | No additional water usage |

gpm = gallons per minute

gph = gallons per hour

lpm = liters per minute

lph = liters per hour

3.0 INDOOR WATER EFFICIENCY CRITERIA

- 3.1 Leaks – There shall be no detected leaks from any water-using fixtures, appliances, or equipment. Compliance shall be verified through pressure-loss testing and visual inspection.
- 3.2 Service Pressure – The static service pressure shall be a maximum of 60 pounds per square inch (psi) (414 kilopascal [kPa]). Compliance for homes supplied by groundwater wells shall be achieved by use of a pressure tank. Compliance for single-family homes with publicly supplied water shall be achieved by one of the following methods:
- Use of a pressure-regulating valve (PRV) downstream of the point of connection. All fixture connections shall be downstream of the PRV.
 - Determination that the service pressure at the home is 60 psi or less at the time of inspection and documentation from the public water supplier that the service pressure is unlikely to regularly exceed 60 psi at the home on a daily or seasonal basis.

For units in multi-family buildings, the service pressure within each unit shall be at a maximum of 60 psi.

- 3.3 Hot Water Delivery System – To minimize water wasted while waiting for hot water, the hot water delivery system shall store no more than 0.5 gallons (1.9 liters) of water in any piping/manifold between the hot water source and any hot water fixture. To account for the additional water that must be removed from the system before hot water can be delivered, no more than 0.6 gallons (2.3 liters) of water shall be collected from the hot water fixture before hot water is delivered. Recirculation systems must be demand-initiated. Systems that are activated based solely on a timer and/or temperature sensor do not meet this requirement.

Internal Volume of Various Water Distribution Tubing⁷

| Ounces of Water Per Foot Length of Hot Water Tubing | | | | | | | | |
|---|----------|----------|----------|-----------------|-------------|------------------------|----------|---------------|
| Nominal Size (Inches) | Copper M | Copper L | Copper K | CPVC CTS SDR 11 | CPVC SCH 40 | PEX-AI-PEX ASTM F 1281 | PE-AL-PE | PEX CTS SDR 9 |
| | 1.06 | 0.97 | 0.84 | N/A | 1.17 | 0.63 | 0.63 | 0.64 |
| ½ | 1.69 | 1.55 | 1.45 | 1.25 | 1.89 | 1.31 | 1.31 | 1.18 |
| ¾ | 3.43 | 3.22 | 2.90 | 2.67 | 3.38 | 3.39 | 3.39 | 2.35 |
| 1 | 5.81 | 5.49 | 5.17 | 4.43 | 5.53 | 5.56 | 5.56 | 3.91 |
| 1¼ | 8.70 | 8.36 | 8.09 | 6.61 | 9.66 | 8.49 | 8.49 | 5.81 |
| 1½ | 12.18 | 11.83 | 11.45 | 9.22 | 13.20 | 13.88 | 13.88 | 8.09 |
| 2 | 21.08 | 20.58 | 20.04 | 15.79 | 21.88 | 21.48 | 21.48 | 13.86 |

Conversions: 1.0 gallon (3.8 liters) = 128.0 ounces
1.0 ounce = 0.00781 gallons (0.0296 liters)
0.5 gallons (1.9 liters) = 64.0 ounces
0.6 gallons (2.3 liters) = 76.8 ounces



WaterSense® New Home Specification

Effective July 24, 2014

Product Detail Information

| | |
|--------------------------|---------------------|
| Brand Name | American Standard |
| Model Name | AquaOption Complete |
| Model Number | 3381.516-xxx |
| Tank Model Number | 4348.516 |
| Bowl Model Number | 3711.216 |
| Flush Type | Dual |
| Flush Mechanism | Gravity |

Please review [important product information](#) before purchasing WaterSense labeled products.

Click to Hide Additional Search Options

| | | |
|---|---|---|
| Product Category Toilets | Brand Name All Brands American Standard | Model Name All Models Access Pro AquaOption Complete Astute VorMax Baby Devoro |
| Model Number | AmeriSink Inc AmGreen Aquasource | |
| Flush Type | Flush Mechanism | |
| <input type="checkbox"/> Select All <input type="checkbox"/> Single <input type="checkbox"/> Dual | <input type="checkbox"/> Select All <input type="checkbox"/> Gravity <input type="checkbox"/> Pressure Assist <input type="checkbox"/> Other | |
| <input type="button" value="Search"/> | <input type="button" value="Reset"/> | |

Number of Products found: 1

Filtered By: Toilets, American Standard, AquaOption Complete, Flush Type:Dual, Flush Mechanism:Gravity

Double-click on a row to view detailed product information.

| Brand Name | Model Name | Model Number | Bowl Model Num |
|-------------------|---------------------|--------------|----------------|
| American Standard | AquaOption Complete | 3381.516-xxx | 3711.216 |

Page 1 of 1

Please note: WaterSense retailer partners commit to making WaterSense labeled products available in stores. However, products may not be available in all markets.

Disclaimer of Endorsement: Reference herein to any specific commercial products, process, or service by trade name, trademark, manufacturer, or otherwise, does not necessarily constitute or imply its endorsement, recommendation, or favoring by the United States Government.

This website here is designed for contractors or owner/manager of the building to find the most efficient water fixtures with the least amount of water use.

WE CREDIT: WATER METERING

BD&C

1 point

This credit applies to

- New Construction (1 point)
- Core & Shell (1 point)
- Schools (1 point)
- Retail (1 point)
- Data Centers (1 point)
- Warehouses & Distribution Centers (1 point)
- Hospitality (1 point)
- Healthcare (1 point)

Intent

To support water management and identify opportunities for additional water savings by tracking water consumption.

Install permanent water meters for two or more of the following water subsystems, as applicable to the project:

- **Irrigation.** Meter water systems serving at least 80% of the irrigated landscaped area. Calculate the percentage of irrigated landscape area served as the total metered irrigated landscape area divided by the total irrigated landscape area. Landscape areas fully covered with xeriscaping or native vegetation that requires no routine irrigation may be excluded from the calculation.
- **Indoor plumbing fixtures and fittings.** Meter water systems serving at least 80% of the indoor fixtures and fitting described in WE Prerequisite Indoor Water Use Reduction, either directly or by deducting all other measured water use from the measured total water consumption of the building and grounds.
- **Domestic hot water.** Meter water use of at least 80% of the installed domestic hot water heating capacity (including both tanks and on-demand heaters).
- **Boiler with aggregate projected annual water use of 100,000 gallons (378 500 liters) or more, or boiler of more than 500,000 BtuH (150 kW).** A single makeup meter may record flows for multiple boilers.
- **Reclaimed water.** Meter reclaimed water, regardless of rate. A reclaimed water system with a makeup water connection must also be metered so that the true reclaimed water component can be determined.
- **Other process water.** Meter at least 80% of expected daily water consumption for process end uses, such as humidification systems, dishwashers, clothes washers, pools, and other subsystems using process water.

Pressure regulator required

residential systems with static pressure in excess of 80 PSI usually have a pressure regulator

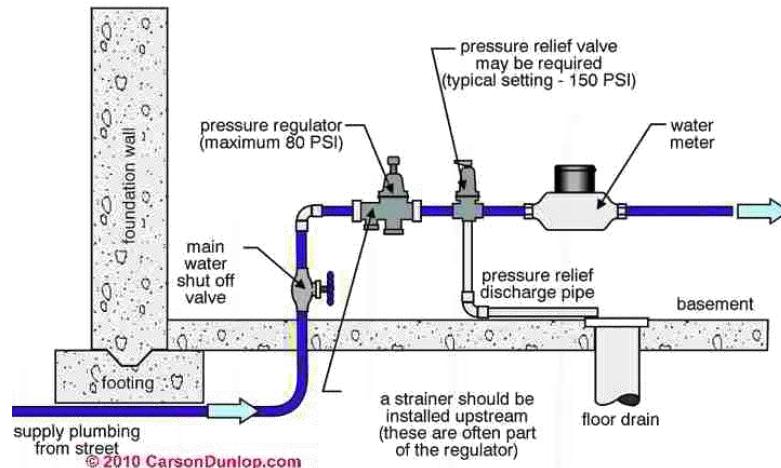


Fig 20: Water metering system

| Dry Bulb Temperature | Relative Humidity | Resultant Wet Bulb Temperature |
|----------------------|-------------------|--------------------------------|
| 40 F | 50 F | 40% |
| 50 F | 60 F | 50% |
| 55 F | 70 F | 35% |
| 73 F | 85 F | 55% |
| 78 F | 90 F | 60% |

Fig 21: The relation between Dry bulb temperature, Relative humidity and Resultant wet bulb temperature

A cooling tower primarily uses latent heat of vaporization (evaporation) to cool process water. Minor additional cooling is provided by the air because of its temperature increase. Since Dallas is considered a subtropical and humid region, The efficiency of cooling tower would be compromised. Therefore using them in Dallas would not be the very best choice. Also cooling tower are considered deleterious from IAQ point of view.
 Most cooling towers are capacity rated at a “standard” wet bulb temperature at 78 F

EA CREDIT: ENHANCED COMMISSIONING

BD&C

2-6 points

This credit applies to

- New Construction (2-6 points)
- Core & Shell (2-6 points)
- Schools (2-6 points)
- Retail (2-6 points)
- Data Centers (2-6 points)
- Warehouses & Distribution Centers (2-6 points)
- Hospitality (2-6 points)
- Healthcare (2-6 points)

Intent

To further support the design, construction, and eventual operation of a project that meets the owner's project requirements for energy, water, indoor environmental quality, and durability.

Complete the following commissioning process (CxP) activities for mechanical, electrical, plumbing, and renewable energy systems and assemblies in accordance with ASHRAE Guideline 0–2005 and ASHRAE Guideline 1.1–2007 for HVAC&R systems, as they relate to energy, water, indoor environmental quality, and durability.

The commissioning authority must do the following:

- Review contractor submittals.
- Verify inclusion of systems manual requirements in construction documents.
- Verify inclusion of operator and occupant training requirements in construction documents.
- Verify systems manual updates and delivery.
- Verify operator and occupant training delivery and effectiveness.
- Verify seasonal testing.
- Review building operations 10 months after substantial completion.
- Develop an on-going commissioning plan.

Include all enhanced commissioning tasks in the OPR and BOD.

Prior to the start of the construction documents phase, an independent commissioning authority (CxA) was designated to lead, review and oversee the completion of all commissioning process activities. Enhanced Commissioning is not just about HVAC or renewable energy, but it covers a wider range from the very start of a project.

EA CREDIT: OPTIMIZE ENERGY PERFORMANCE

BD&C

1–20 points

This credit applies to

- New Construction (1–18 points)
- Core & Shell (1–18 points)
- Schools (1–16 points)
- Retail (1–18 points)
- Data Centers (1–18 points)
- Warehouses & Distribution Centers (1–18 points)
- Hospitality (1–18 points)
- Healthcare (1–20 points)

Intent

To achieve increasing levels of energy performance beyond the prerequisite standard to reduce environmental and economic harms associated with excessive energy use.

Analyze efficiency measures during the design process and account for the results in design decision making. Use energy simulation of efficiency opportunities, past energy simulation analyses for similar buildings, or published data (e.g., Advanced Energy Design Guides) from analyses for similar buildings.

Analyze efficiency measures, focusing on load reduction and HVAC-related strategies (passive measures are acceptable) appropriate for the facility. Project potential energy savings and holistic project cost implications related to all affected systems.

Project teams pursuing the Integrative Process credit must complete the basic energy analysis for that credit before conducting the energy simulation.

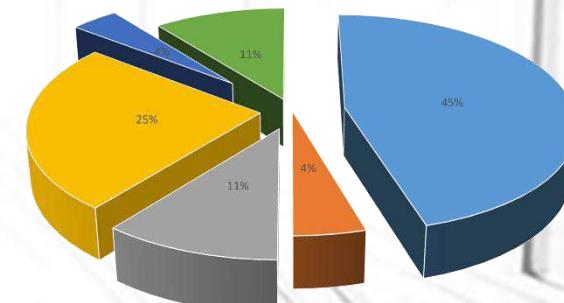
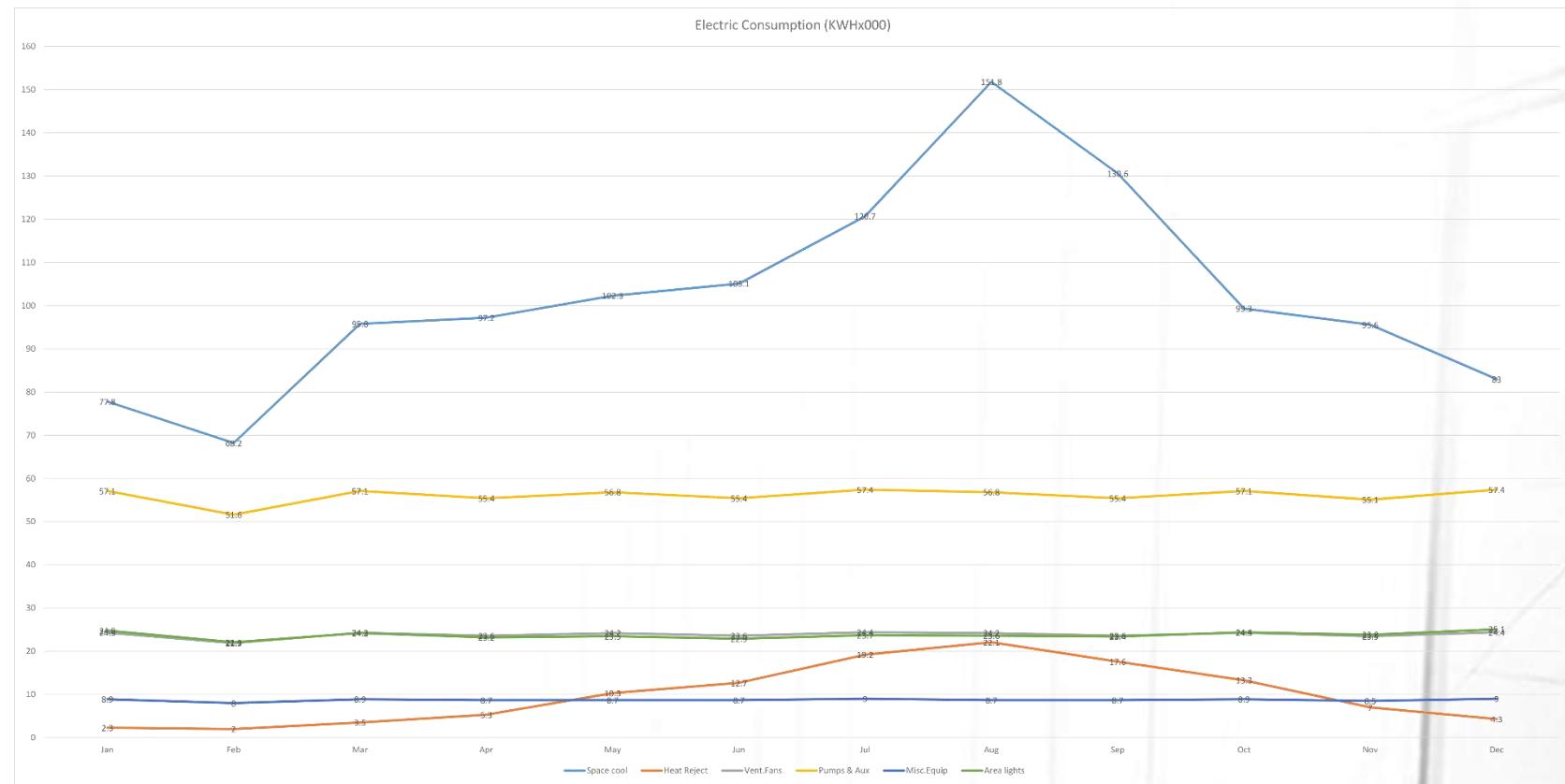
Follow the criteria in [EA Prerequisite Minimum Energy Performance](#) to demonstrate a percentage improvement in the proposed building performance rating compared with the baseline. Points are awarded according to Table 1.

- Sparsely populated building with little activities like residential buildings, are generally dominated by external heat loads, the energy demand which comes from heat transfer between the building envelope and the sun, outside and the environment.
- Passive systems reduce the energy demand or meet it naturally.
- It usually takes more energy to meet heating loads than it does to meet cooling loads.
- Fuel is less cheaper and more efficient than a source electricity, unless the electricity is provided in the site(PV solar panels).

26,953.000 KWh electricity is annually used for this building. Almost half of this amount (46%), is exclusively delegated to space cooling by using Evaporate cooling in the building, and this amount of electricity has a high peak during the summer.

Because of the moist and therefore the latent heat, having a natural ventilation and using pre-night cooling can help us to reduce a significant amount of electricity to half.

Also, using PV solar panels in the site can increase the electricity efficiency up to 5 times compared to power plant.



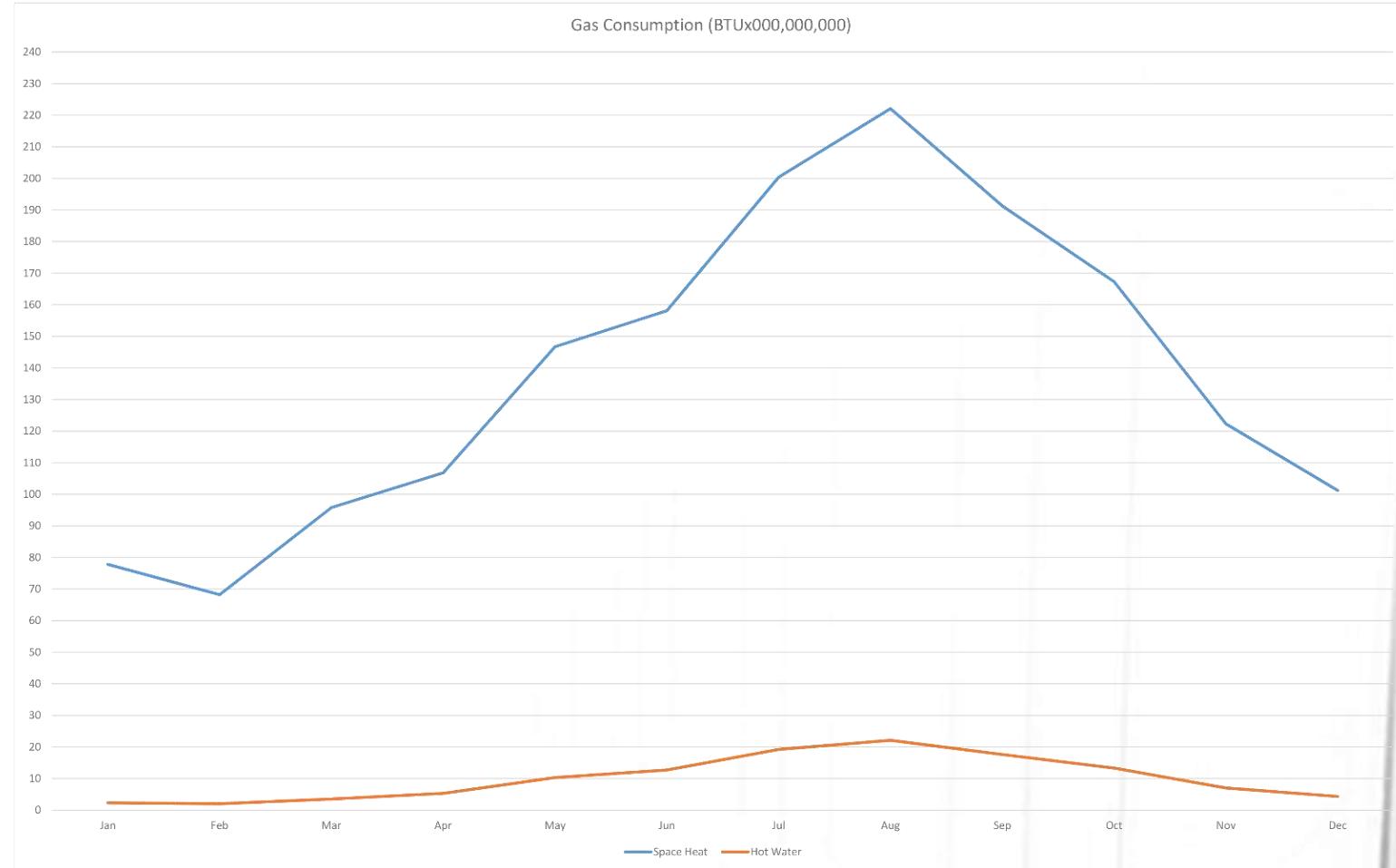
■ Space cool ■ Heat Reject ■ Vent.Fans ■ Pumps & Aux ■ Misc.Equip. ■ Area lights

Space heating dominates energy use and its primarily met by natural gas

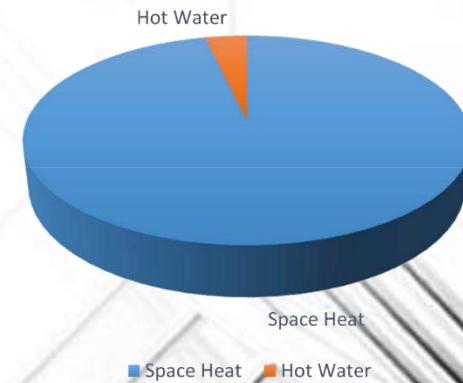
Water heating, which has a pittance share in the gas consumption compare to space heat, is the second largest energy use which also usually met by natural gas.

The whole amount of gas consumption is $1777.6e+6$ BTU

Each Kwh is equaled to 3412.14 BTU, therefore the whole energy usage of the building from gas and electronic source would be:

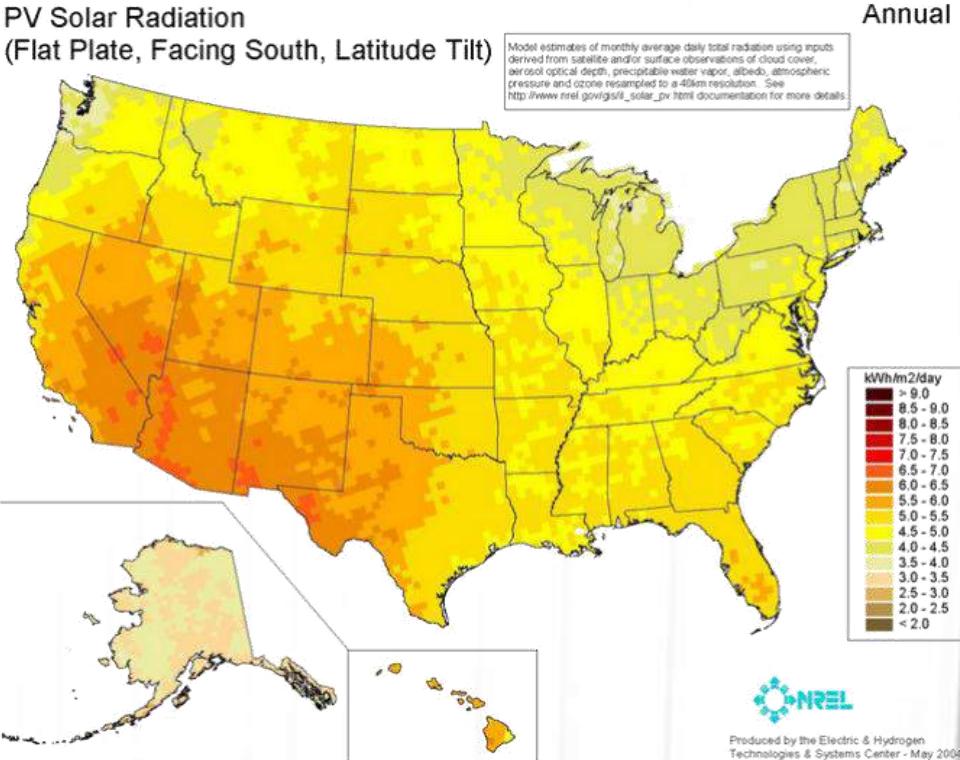


$$26,953.000 \times 3412.14 + 1777.6 \times 10e+6 = \mathbf{1869.567e+8} \text{ BTU}$$



Based on the PV Solar radiation map produced by Electronic & Hydrogen Technologies and Systems Center in May 2004, Dallas has the capacity to gain 5-5.5 kwh/m²/day of solar radiation.

If we assume that %90 of this amount would be harvested due to the inconvenience situations such as limited technology, unpredicted climate conditions and etc. Then according to our building plan we would have $5.3 \times 4.6 \times 0.7 \times 108 \times 365 \times 0.9 = 605,467.548 \text{ kwh}$ electricity produced by a renewable energy source.



Percentage of energy produced in site compared to the whole energy usage

$$605,467.548 \times 3412.14e+6 / 1869.567e+6 = \%110.5$$

Which means not only we would have an improvement in our energy use, but also the building would be considered as net zero, cause it can provide the energy it uses by harvesting natural resources

EA CREDIT: ADVANCED ENERGY METERING

BD&C

1 point

This credit applies to

- New Construction (1 point)
- Core & Shell (1 point)
- Schools (1 point)
- Retail (1 point)
- Data Centers (1 point)
- Warehouses & Distribution Centers (1 point)
- Hospitality (1 point)
- Healthcare (1 point)

Intent

To support energy management and identify opportunities for additional energy savings by tracking building-level and system-level energy use.

Install advanced energy metering for the following:

- all whole-building energy sources used by the building; and
- any individual energy end uses that represent 10% or more of the total annual consumption of the building.

The advanced energy metering must have the following characteristics.

- **Meters must be permanently installed**, record at intervals of one hour or less, and transmit data to a remote location.
- Electricity meters must record both **consumption and demand**. Whole-building electricity meters should record the power factor, if appropriate.
- The data collection system must use a local area network, building automation system, wireless network, or comparable communication infrastructure.
- The system must be capable of storing all meter data for at least 36 months.
- The data must be remotely accessible.
- All meters in the system must be capable of reporting hourly, daily, monthly, and annual energy use.



Different kinds of advanced energy meters

EA CREDIT: DEMAND RESPONSE

BD&C

1–2 points

This credit applies to

- New Construction (1–2 points)
- Core & Shell (1–2 points)
- Schools (1–2 points)
- Retail (1–2 points)
- Data Centers (1–2 points)
- Warehouses & Distribution Centers (1–2 points)
- Hospitality (1–2 points)
- Healthcare (1–2 points)

Intent

To increase participation in demand response technologies and programs that make energy generation and distribution systems more efficient, increase grid reliability, and reduce greenhouse gas emissions.

- Participate in an existing demand response (DR) program and complete the following activities. Design a system with the capability for real-time, fully-automated DR based on external initiation by a DR Program Provider. Semi-automated DR may be utilized in practice.
- Enroll in a minimum one-year DR participation amount contractual commitment with a qualified DR program provider, with the intention of multiyear renewal, for at least 10% of the estimated peak electricity demand. Peak demand is determined under EA Prerequisite Minimum Energy Performance.
- Develop a comprehensive plan for meeting the contractual commitment during a Demand Response event.
- Include the DR processes in the scope of work for the commissioning authority, including participation in at least one full test of the DR plan.

Demand response provides an opportunity for consumers to play a significant role in the operation of the electric grid by reducing or shifting their electricity usage during peak periods in response to time-based rates or other forms of financial incentives. Demand response programs are being used by electric system planners and operators as resource options for balancing supply and demand. Such programs can lower the cost of electricity in wholesale markets, and in turn, lead to lower retail rates

Here is an example of the discussions and in a demand response program which was held in Texas in April 04,2014 by Cirro Energy Services and presented by Fazil Shaikh, Sales Manager and Mellisa Karner, Energy Consultant.

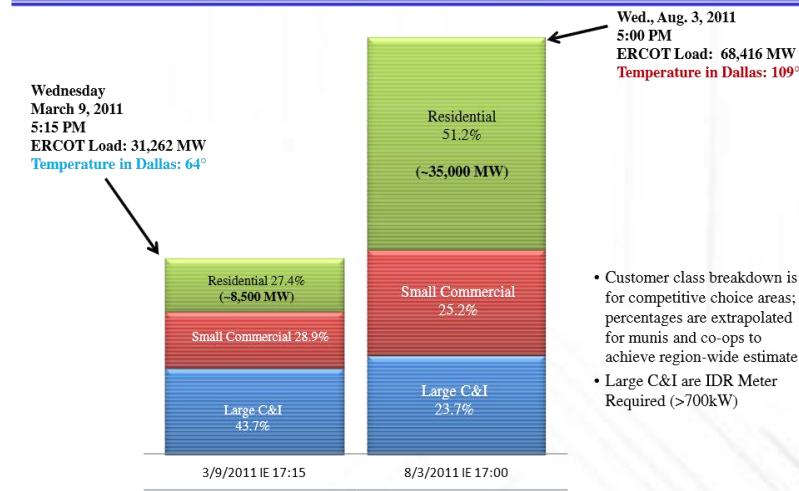
| Feb 2014 ERCOT Capacity, Demand, and Reserves Forecast | | | | | | | | | | |
|---|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|
| 2014 Report on the Capacity, Demand, and Reserves in the ERCOT Region | | | | | | | | | | |
| Summer Summary | | | | | | | | | | |
| Load Forecast: | | | | | | | | | | |
| Total Summer Peak Demand, MW | 2014 | 2015 | 2016 | 2017 | 2018 | 2019 | 2020 | 2021 | 2022 | 2023 |
| less LRs Serving as Responsive Reserve, MW | 68,098 | 69,257 | 70,014 | 70,371 | 71,026 | 72,859 | 73,784 | 74,710 | 75,631 | 76,550 |
| less LRs Serving as Non-Spinning Reserve, MW | 1,221 | 1,221 | 1,231 | 1,231 | 1,231 | 1,231 | 1,231 | 1,231 | 1,231 | 1,231 |
| less Emergency Reserve Margin (10- and 20-min ramp products) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| less ERCOT Demand Curve Management Programs | 431 | 442 | 452 | 452 | 452 | 452 | 452 | 452 | 452 | 452 |
| Firm Load Forecast, MW | 66,179 | 67,139 | 68,098 | 68,953 | 69,898 | 70,941 | 71,886 | 72,792 | 73,713 | 74,632 |
| Resources, MW | 74,805 | 77,492 | 77,763 | 77,995 | 79,274 | 78,674 | 78,674 | 78,974 | 78,974 | 78,974 |
| Reserve Margin | 13.0% | 15.4% | 14.1% | 12.8% | 13.4% | 10.9% | 9.5% | 8.5% | 7.1% | 5.8% |

- The report indicates that the reserve margin (ratio of peak supply to demand) is not diminishing as rapidly as originally thought.
- The report does not include 2,300MW's of new generation in the queue for 2015-2016 because they have not yet received air permits:
- Assuming just half of these (2300MWs) come online the 2015-2017 reserve margins would improve to 16.2%, 15.8%, and 14.5%, respectively.
- Electricity, to date, cannot be stored in large quantities. Therefore, the traditional model is to build physical generation plants to be able to meet peak demand, which only occurs a fraction of the year.
- Demand Response: Temporary reduction, or shifting of power in response to grid reliability and/or economic conditions.

What is more efficient: building a multi-million dollar generator that may sit idle for a majority percentage of the year, or aggregate customers who can reduce usage a few times a year?

- DR programs vary... ERCOT programs, Utility programs, Proprietary programs...

Off-peak vs. on-peak load by customer type



Paul Wattles, ERCOT, Presented at Data Center Dynamics, Dec 11, 2012

EA CREDIT: RENEWABLE ENERGY PRODUCTION

BD&C

1–3 points

This credit applies to

- New Construction (1–3 points)
- Core & Shell (1–3 points)
- Schools (1–3 points)
- Retail (1–3 points)
- Data Centers (1–3 points)
- Warehouses & Distribution Centers (1–3 points)
- Hospitality (1–3 points)
- Healthcare (1–3 points)

Intent

To reduce the environmental and economic harms associated with fossil fuel energy by increasing self-supply of renewable energy.

Use renewable energy systems to offset building energy costs. Calculate the percentage of renewable energy with the following equation:

$$\% \text{ renewable energy} = \frac{\text{Equivalent cost of usable energy produced by the renewable energy system}}{\text{Total building annual energy cost}}$$

Use the building's annual energy cost, calculated in EA Prerequisite Minimum Energy Performance, if Option 1 was pursued; otherwise use the U.S. Department of Energy's Commercial Buildings Energy Consumption Survey (CBECS) database to estimate energy use and cost.

The use of solar gardens or community renewable energy systems is allowed if both of the following requirements are met.

- The project owns the system or has signed a lease agreement for a period of at least 10 years.
- The system is located with the same utility service area as the facility claiming the use.

Table 1. Points for renewable energy

| <i>Percentage renewable energy</i> | <i>Points (except CS)</i> | <i>Points (CS)</i> |
|------------------------------------|---------------------------|--------------------|
| 1% | 1 | 1 |
| 3% | — | 2 |
| 5% | 2 | 3 |
| 10% | 3 | — |

The information about natural gas and electricity has been derived from HEED software

ELECTRIC CHARGES:

For **SOUTHERN CALIFORNIA EDISON** Typical Rates for 2010

Winter Season Value of Electricity Consumed during months October to May
Basic charge for meter hookup 243 Days x \$0.02900 per day = \$7.05

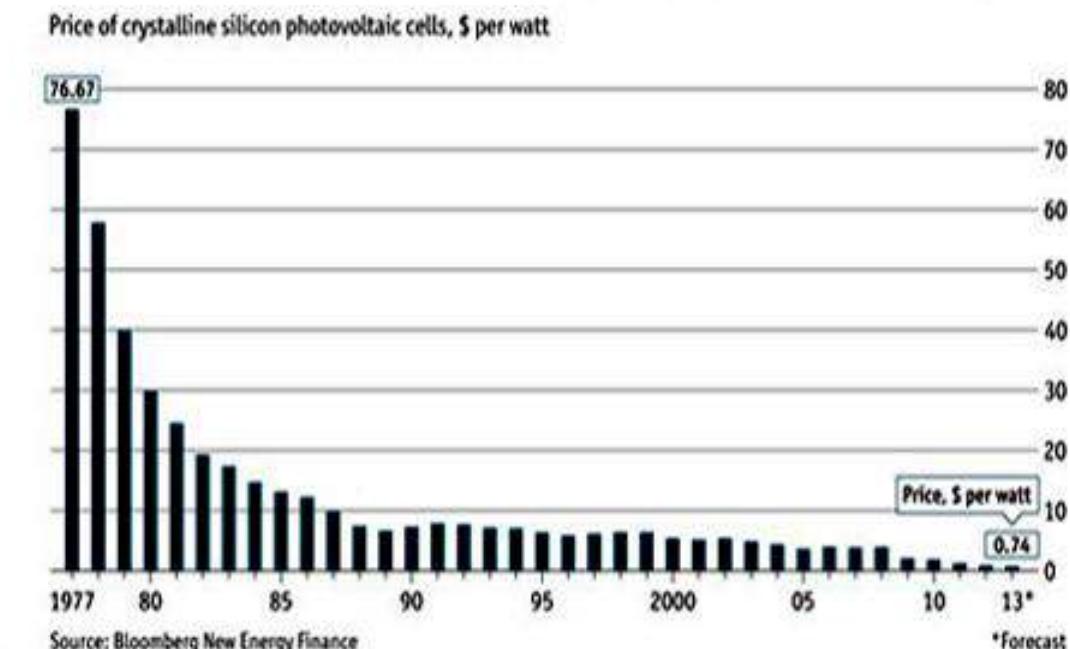
Baseline, charge for energy used 2,236 kWh x \$0.12545 per kWh = \$280.46
Over Baseline (100-130%) 671 kWh x \$0.14537 per kWh = \$97.50
Tier III (130-200% of Baseline) 1,565 kWh x \$0.23727 per kWh = \$371.31
Tier IV (200-300% of Baseline) 1,925 kWh x \$0.27224 per kWh = \$523.96
Tier V (Over 300% of Baseline) 308 kWh x \$0.30725 per kWh = \$94.66

Summer Season Value of Electricity Consumed during months June to September
Basic charge for meter hookup 122 Days x \$0.02900 per day = \$3.54

Baseline, charge for energy used 1,110 kWh x \$0.12545 per kWh = \$139.27
Over Baseline (100-130%) 333 kWh x \$0.14537 per kWh = \$48.42
Tier III (130-200% of Baseline) 777 kWh x \$0.23727 per kWh = \$184.39
Tier IV (200-300% of Baseline) 968 kWh x \$0.27224 per kWh = \$263.65
Tier V (Over 300% of Baseline) 985 kWh x \$0.30725 per kWh = \$302.58

TOTAL COST (not including taxes) = \$2,316.77

- photovoltaic (PV) solar cell prices have come down by a factor of 100 over the last 35 years; and down by a factor of 10 over the last 15 year
- The 2015 Q1 average solar cell price was \$0.31 per watt and the average solar module price was \$0.72 per watt.
- Since costs after installation are minimal for solar electricity, the relevant costs are the purchase price, installation costs, and the cost of land (capital costs)
- With the new technology getting more advanced every day, the PV solar panels are getting cheaper and cheaper every day



EA CREDIT: ENHANCED REFRIGERANT MANAGEMENT

BD&C

1 point

This credit applies to

- New Construction (1 point)
- Core & Shell (1 point)
- Schools (1 point)
- Retail (1 point)
- Data Centers (1 point)
- Warehouses & Distribution Centers (1 point)
- Hospitality (1 point)
- Healthcare (1 point)

Intent

To reduce ozone depletion and support early compliance with the Montreal Protocol while minimizing direct contributions to climate change.

Do not use refrigerants, or use only refrigerants (naturally occurring or synthetic) that have an ozone depletion potential (ODP) of zero and a global warming potential (GWP) of less than 50.

| Type | ASHRAE Number | IUPAC Chemical Name | Molecular Formula | CAS registry number/ Blend Name | Atmospheric Lifetimes (years) | Semi-Empirical ODP | net GWP 100-yr | OEP/PEM (v/v) & ASHRAE 34 ppm (v/v) | RCL/ IDLH ppm | IDLH/ g/m³ | Molecular mass u | Normal Boiling OR Bubble-Dev (Azeotropic Point) °C | Critical Temp. °C | Critical Pressure (absolute) kPa |
|------|---------------|--|--|------------------------------------|-------------------------------|---------------------------|-----------------------|---|---|---|----------------------|--|-----------------------|--|
| PCC | R-10 | Carbon tetrachloride (Tetrachloroethane) | CCl ₄ | 56-23-5 | 26 ^{[1][2]} | 0.73 ^[2] | 1,400 ^[1] | 100 ^{[1][3]} | | | 153.8 ^[4] | 76.72 ^[5] | 283.3 ^[6] | 4,560 ^[6] |
| CFC | R-11 | Trichloroethane | CCl ₃ F | 75-69-4 | 45 ^{[1][2]} | 1.0 ^[2] | 4,750 ^[1] | 1,000 ^[7] AH ^[7] | 1,000 ^[7] AH ^[7] | 18,000 ^[7] | 120.0 ^[4] | 29.8 ^[4] | 111.0 ^[6] | 4,136 ^[6] |
| CFC | R-12 | Dichlorodifluoromethane | CCl ₂ F ₂ | 75-71-8 | 100 ^{[1][2]} | 1.0 ^[2] | 10,900 ^[1] | 1,000 ^[7] AH ^[7] | 1,000 ^[7] AH ^[7] | 18,000 ^[7] | 120.0 ^[4] | 20.8 ^[4] | 153.8 ^[6] | 4,102 ^[6] |
| H | R-12B1 | Bromochlorodifluoromethane | CHBrClF ₂ or CF ₃ ClBr | 353-59-3 | 16 ^{[1][2]} | 7.1 ^[2] | 1,890 ^[1] | | | | 165.4 ^[4] | -3.7 ^[6] | 153.8 ^[6] | 4,136 ^[6] |
| H | R-12B2 | Dibromo-difluoromethane | CHBr ₂ F ₂ | 75-61-6 | 2 ^{[1][2]} | 1.7 ^[2] | | | | | 209.8 ^[4] | 22.8 ^[7] | 198.1 ^[6] | 4,130 ^[6] |
| CFC | R-13 | Chlorotrifluoroethane | CClF ₃ | 75-72-9 | 640 ^[1] | 1 ^[2] | 14,400 ^[1] | 1,000 ^[7] AH ^[7] | 40,000 ^[7] | 2007 | 104.5 ^[4] | -81.5 ^[4] | 28.73 ^[4] | 3,877 ^[6] |
| H | R-13B1 | Bromotrifluoroethane | CCl ₂ BrF | 75-63-8 | 68 ^{[1][2]} | 1.6 ^[2] | 7,140 ^[1] | 1,000 ^[7] AH ^[7] | 1,000 ^[7] AH ^[7] | 1,000 ^[7] AH ^[7] | 148.9 ^[4] | -57.75 ^[7] | 67.0 ^[7] | 3,964 ^[6] |
| PFC | R-14 | Tetrafluoroethane | CF ₄ | 75-73-0 | 50,000 ^[1] | 0 ^[2] | 7,390 ^[1] | 1,000 ^[7] AH ^[7] | 10,000 ^[7] | 400 ^[7] | 88 ^[4] | -127.8 ^[7] | -45.6 ^[6] | 3,750 ^[6] |
| HCC | R-20 | Chloroform (Trichloromethane) | CHCl ₃ | 67-66-3 | 0.5 ^[1] | | 31 ^[1] | | | | 119.4 ^[4] | 61.2 ^[5] | 262.3 ^[6] | 5,480 ^[6] |
| HCTC | R-21 | Dichlorodifluoromethane | CHFCl ₂ | 75-14-4 | 1.7 ^[2] | 0.04 ^[10] | 15 ^[2] | 100 ^{[1][3]} | | | 102.0 ^[4] | 8.9 ^[7] | 178.4 ^[6] | 5,180 ^[6] |
| HCTC | R-22 | Chlorodifluoromethane | CHClF ₂ | 75-45-6 | 12 ^{[1][2]} | 0.05 ^[2] | 1,810 ^[1] | 1,000 ^[7] AH ^[7] | 59,000 ^[7] | 210 ^[7] | 86.5 ^[4] | -40.7 ^[4] | 96.14 ^[6] | 4,950 ^[6] |
| H | R-22B1 | Bromodifluoromethane | CHBrF ₂ or CHF ₂ Br | 1511-62-2 | 5.8 ^[2] | 0.74 ^[2] | 404 ^[2] | | | | 130.9 ^[4] | -14.6 ^[4] | 138.8 ^[6] | 5,132 ^[6] |
| HFC | R-23 | Tetrafluoroethane (Fluorofluorane) | CHF ₃ | 75-46-7 | 276 ^[1] | 0 ^[2] | 14,800 ^[1] | 1,000 ^[7] AH ^[7] | 41,000 ^[7] | 126 ^[7] | 70 ^[4] | -82.1 ^[5] | 25.92 ^[6] | 4,836 ^[6] |
| HCC | R-30 | Dichloromethane (Methylene Chloride) | CH ₂ Cl ₂ | 73-09-2 | 0.38 ^[1] | 0.01 ^[1] | 8.7 ^[1] | 100 ^{[1][2]} | | | 84.9 ^[4] | 39.6 ^[5] | 235.1 ^[6] | 6,080 ^[6] |
| HCTC | R-31 | Chlorofluoromethane | CH ₂ ClF | 593-70-4 | | 0.02 ^[10] | | 350 ^{[1][2]} | 10,000 ^[7] | 20 ^[7] | 68.5 ^[4] | -9.1 ^[6] | 151.76 ^[6] | 5,131 ^[6] |
| HFC | R-32 | Difluoromethane | CH ₂ F ₂ | 75-10-5 | 4.9 ^[1] | 0 ^[2] | 675 ^[1] | 1,000 ^[7] AH ^[7] | 36,000 ^[7] | 77 ^[7] | 52 ^[4] | -78.1 ^[5] | 57.82 ^[6] | |
| HCC | R-40 | Chloroform | CH ₂ Cl | 74-87-3 | 1.0 ^{[1][2]} | 0.02 ^[2] | 13 ^[1] | 100 ^{[1][3]} | | | 50.5 ^[4] | -24.2 ^[4] | 143.0 ^[6] | 6,650 ^[6] |
| HFC | R-41 | Fluoromethane | CH ₃ F | 593-53-3 | 2 ^{[1][2]} | 0 ^[2] | 92 ^[1] | | | | 34 ^[4] | -78.2 ^[5] | 44.13 ^[6] | 5,397 ^[6] |
| H | R-50 | Methane | CH ₄ | 74-82-8 | 12 ± 3 ^[1] | <0.0001 ^[14] | 25 ^[1] | 1,000 ^[7] AH ^[7] | 9,000 ^[7] | 97 | 16.0 ^[4] | -162.2 ^[2] | -82.3 ^[15] | 4,640 ^[15] |
| PCC | R-110 | Hexachloroethane | C ₂ Cl ₆ | 67-72-7 | | | | | | | 236.7 ^[4] | | 431.2 ^[6] | 5,397 ^[6] |
| CFC | R-111 | Pentachloroethane | C ₂ Cl ₅ F ₅ | 354-56-3 | | 1 ^[2] | | | | | 220.0 ^[4] | 13 ^[4] | | |
| CFC | R-112 | 1,1,2,2-Tetrachloro-1,1-difluoroethane | C ₂ F ₂ Cl ₄ | 76-12-0 | | 1 ^[2] | | | | | 203.8 ^[4] | | | |
| CFC | R-112a | 1,1,1,2-Tetrachloro-2,2-difluoroethane | C ₂ F ₂ Cl ₄ | 76-11-9 | | 1 ^[4] | | | | | 203.8 ^[4] | | | |
| CFC | R-113 | 1,1,2-Trihaloethane | CCl ₂ F ₆ | 76-13-1 | 85 ^{[1][2]} | 1.0 ^[2] | 6,130 ^[1] | 1,000 ^[7] AH ^[7] | 2,600 ^[7] | 20 ^[7] | 187.4 ^[4] | 481 ^[1] | 214.0 ^[6] | 3,392 ^[6] |
| CFC | R-113a | 1,1,1-Trihaloethane | CCl ₃ F ₅ | 354-58-5 | | 1 ^[4] | | | | | 187.4 ^[4] | | | |
| CFC | R-114 | 1,2-Dihaloethane | C ₂ HF ₄ | 76-14-2 | 300 ^{[1][2]} | 1.0 ^[2] | 10,000 ^[1] | 1,000 ^[7] AH ^[7] | 20,000 ^[7] | 140 ^[7] | 170.9 ^[4] | 3.5 ^[3] | 145.6 ^[6] | 3,257 ^[6] |
| CFC | R-114a | 1,1-Dihaloethane | C ₂ HF ₄ | 374-07-2 | | 1 ^[4] | | | | | 170.9 ^[4] | | | |
| H | R-114B2 | 1,2-Dibromoethane | C ₂ Br ₂ H ₂ | 124-73-2 | 20 ^{[1][2]} | 11 ^[4] | 1,640 ^[1] | | | | 259.6 ^[4] | 47.5 ^[5] | 214.6 ^[6] | |
| CFC | R-115 | Chloropentafluoroethane | CCl ₂ F ₅ | 76-15-3 | 1,700 ^{[1][2]} | 0.44 ^[2] | 7,370 ^[1] | 1,000 ^[7] AH ^[7] | 120,000 ^[7] | 766 ^[7] | 154.5 ^[4] | -39.1 ^[6] | 79.95 ^[6] | 3,120 ^[6] |
| PFC | R-116 | Hexafluoroethane | C ₂ F ₆ | 76-16-4 | 10,000 ^[1] | 0 ^[2] | 12,209 ^[1] | 1,000 ^[7] AH ^[7] | 97,000 ^[7] | 550 ^[7] | 138 ^[4] | -78.2 ^[5] | 19.88 ^[6] | 3,042 ^[6] |
| HCC | R-120 | Pentafluoroethane | C ₂ HF ₅ | 76-01-7 | | | | | | | 202.3 ^[4] | | | |
| HCF | R-121 | 1,1,2,2-Tetrahalo-1,1-difluoethane | C ₂ HF ₄ Cl ₂ | 354-14-3 | | 0.01-0.04 ^[10] | | | | | 185.6 ^[4] | | | |
| HCF | R-121a | 1,1,2-Trihaloethane | C ₂ HF ₃ Cl ₂ | 354-11-0 | | 0.01-0.6 ^[10] | | | | | 185.6 ^[4] | | | |
| HCF | R-122 | 1,1,2-Trihalo-2,2-difluoroethane | C ₂ HF ₂ Cl ₂ | 354-21-2 | | 0.02-0.08 ^[10] | | | | | 169.4 ^[4] | | | |
| HCTC | R-122a | 1,1,2-Trihalo-1,1-difluoroethane | C ₂ HF ₃ Cl ₂ | 354-15-4 | | 0.02-0.08 ^[10] | | | | | 169.4 ^[4] | | | |
| HCF | R-122b | 1,1,1-Trihalo-2,2-difluoroethane | C ₂ HF ₂ Cl ₃ | 354-41-1 | | 0.02-0.08 ^[10] | | | | | 169.4 ^[4] | | | |
| HCTC | R-123 | 2,2-Dibromo-1,1,1-trifluoroethane | C ₂ HF ₂ Cl ₂ | 306-83-2 | 1,3 ^{[1][2]} | 0.02 ^[2] | 77 ^[1] | 50 ^{[1][3]} | 9,100 ^[7] | 57 ^[7] | 152.9 ^[4] | 27.6 ^[5] | 183.6 ^[6] | 3,662 ^[6] |

CFCs are the most common refrigerants used which have a high ODP, HFCs and HFOs are the new alternative with a zero ODP. The table above is a list of refrigerants and the one with a zero ODP are highlighted

EA CREDIT: GREEN POWER AND CARBON OFFSETS

BD&C

1–2 points

This credit applies to

- New Construction (1–2 points)
- Core & Shell (1–2 points)
- Schools (1–2 points)
- Retail (1–2 points)
- Data Centers (1–2 points)
- Warehouses & Distribution Centers (1–2 points)
- Hospitality (1–2 points)
- Healthcare (1–2 points)

Intent

To encourage the reduction of greenhouse gas emissions through the use of grid-source, renewable energy technologies and carbon mitigation projects.

Engage in a contract for qualified resources that have come online since January 1, 2005, for a minimum of five years, to be delivered at least annually. The contract must specify the provision of at least 50% or 100% of the project's energy from green power, carbon offsets, or renewable energy certificates (RECs).

Green power and RECs must be Green-e Energy certified or the equivalent. RECs can only be used to mitigate the effects of Scope 2, electricity use.

Carbon offsets may be used to mitigate Scope 1 or Scope 2 emissions on a metric ton of carbon dioxide-equivalent basis and must be Green-e Climate certified, or the equivalent.

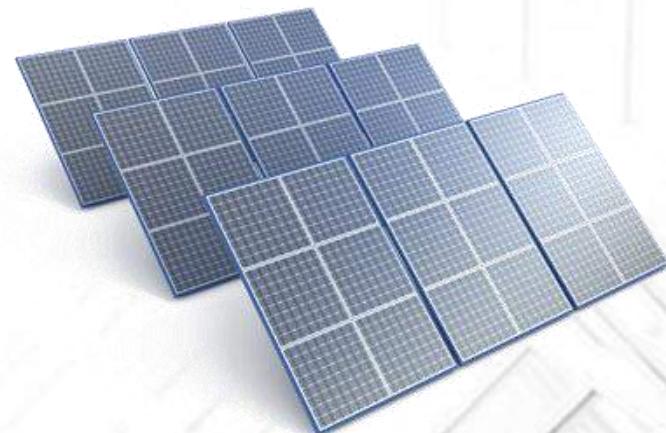
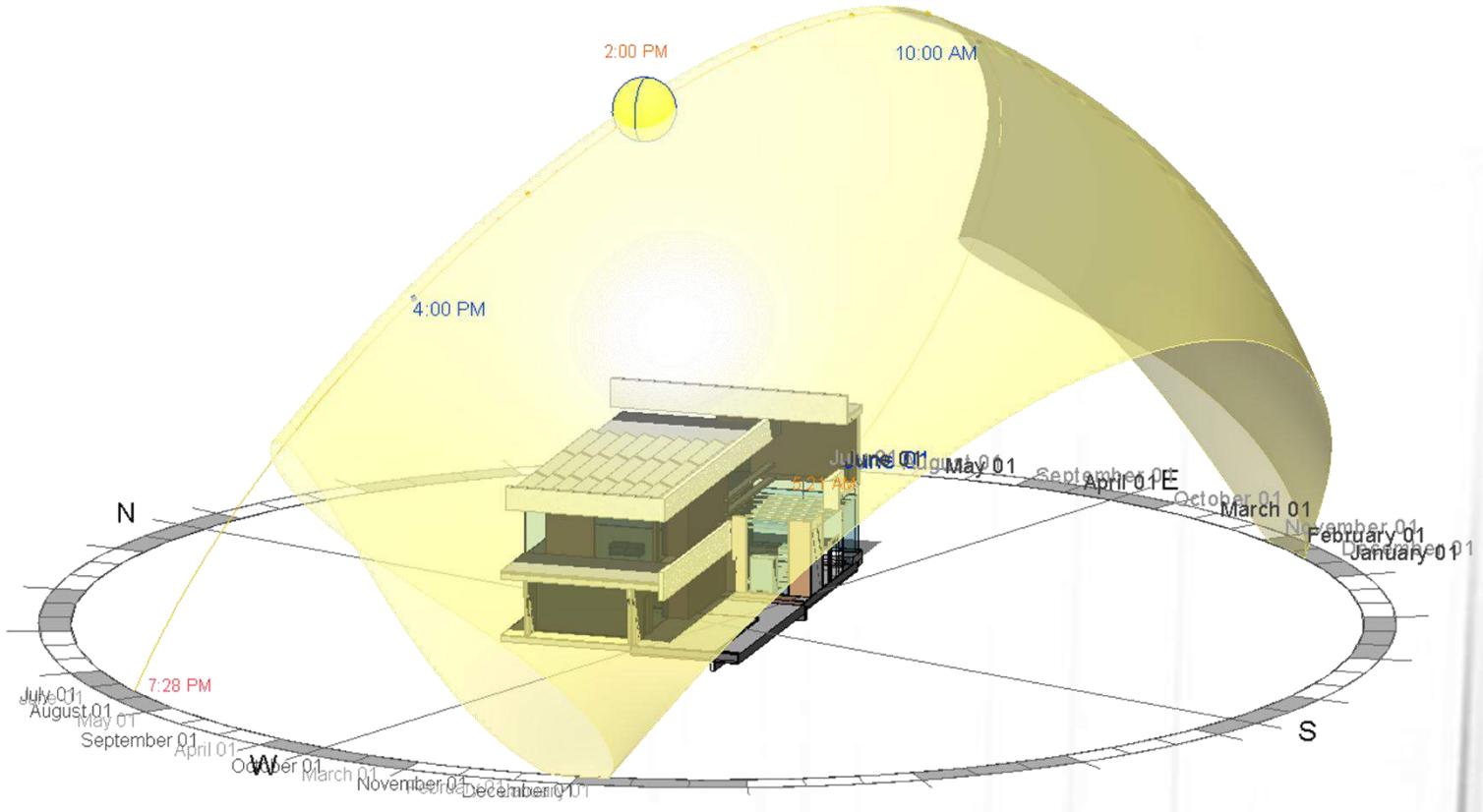
For U.S. projects, the offsets must be from greenhouse gas emissions reduction projects within the U.S.

Determine the percentage of green power or offsets based on the quantity of energy consumed, not the cost. Points are awarded according to Table 1.

Table 1. Points for energy from green power or carbon offsets

| <i>Percentage of total energy addressed by green power, RECs and/or offsets</i> | <i>Points</i> |
|---|---------------|
| 50% | 1 |
| 100% | 2 |

Installing PV solar panels on the roof in the right angle so it would not be in the shade, can be a good source for using renewable energy and therefore helps us to reduce the carbon footprint



MR CREDIT: BUILDING LIFE-CYCLE IMPACT REDUCTION

BD&C

2–6 points

This credit applies to

- New Construction (2–5 points)
- Core & Shell (2–6 points)
- Schools (2–5 points)
- Retail (2–5 points)
- Data Centers (2–5 points)
- Warehouses & Distribution Centers (2–5 points)
- Hospitality (2–5 points)
- Healthcare (2–5 points)

Intent

To encourage adaptive reuse and optimize the environmental performance of products and materials.

Option 1. Historic Building Reuse (5 points BD&C, 6 points Core and Shell)

Option 2. Renovation of Abandoned or Blighted Building (5 points BD&C, 6 points Core and Shell)

Option 3. Building and Material Reuse (2–4 points BD&C, 2–5 points Core and Shell)

Reuse or salvage building materials from off site or on site as a percentage of the surface area, as listed in Table 1. Include structural elements (e.g., floors, roof decking), enclosure materials (e.g., skin, framing), and permanently installed interior elements (e.g., walls, doors, floor coverings, ceiling systems). Exclude from the calculation window assemblies and any hazardous materials that are remediated as a part of the project.

Materials contributing toward this credit may not contribute toward MR Credit Material Disclosure and Optimization.

Table 1. Points for reuse of building materials

| Percentage of completed project surface area reused | Points BD&C | Points BD&C (Core and Shell) |
|---|-------------|------------------------------|
| 25% | 2 | 2 |
| 50% | 3 | 3 |
| 75% | 4 | 5 |

The previous building located on the site was a 20 year old house with families living inside it. Therefore options 1 & 2 of this credit do not apply for this condition.

**MR CREDIT: BUILDING PRODUCT DISCLOSURE AND OPTIMIZATION—
ENVIRONMENTAL PRODUCT DECLARATIONS**

BD&C

1–2 points

This credit applies to

- New Construction (1–2 points)
- Core & Shell (1–2 points)
- Schools (1–2 points)
- Retail (1–2 points)
- Data Centers (1–2 points)
- Warehouses & Distribution Centers (1–2 points)
- Hospitality (1–2 points)
- Healthcare (1–2 points)

Intent

To encourage the use of products and materials for which life-cycle information is available and that have environmentally, economically, and socially preferable life-cycle impacts. To reward project teams for selecting products from manufacturers who have verified improved environmental life-cycle impacts.

Use at least 20 different permanently installed products sourced from at least five different manufacturers that meet one of the disclosure criteria below.

- Product-specific declaration.
 - Products with a publicly available, critically reviewed life-cycle assessment conforming to ISO 14044 that have at least a cradle to gate scope are valued as one quarter (1/4) of a product for the purposes of credit achievement calculation.
- Environmental Product Declarations which conform to ISO 14025, 14040, 14044, and EN 15804 or ISO 21930 and have at least a cradle to gate scope.
 - Industry-wide (generic) EPD -- Products with third-party certification (Type III), including external verification, in which the manufacturer is explicitly recognized as a participant by the program operator are valued as one half (1/2) of a product for purposes of credit achievement calculation.
 - Product-specific Type III EPD -- Products with third-party certification (Type III), including external verification in which the manufacturer is explicitly recognized as the participant by the program operator are valued as one whole product for purposes of credit achievement calculation.
- USGBC approved program – Products that comply with other USGBC approved environmental product declaration frameworks.

For credit achievement calculation, products sourced (extracted, manufactured, purchased) within 100 miles (160 km) of the project site are valued at 200% of their base contributing cost.

**MR CREDIT: BUILDING PRODUCT DISCLOSURE AND OPTIMIZATION –
SOURCING OF RAW MATERIALS**

BD&C

1–2 points

This credit applies to

- New Construction (1–2 points)
- Core & Shell (1–2 points)
- Schools (1–2 points)
- Retail (1–2 points)
- Data Centers (1–2 points)
- Warehouses & Distribution Centers (1–2 points)
- Hospitality (1–2 points)
- Healthcare (1–2 points)

Intent

To encourage the use of products and materials for which life cycle information is available and that have environmentally, economically, and socially preferable life cycle impacts. To reward project teams for selecting products verified to have been extracted or sourced in a responsible manner.

Option 1. Raw Material Source and Extraction Reporting (1 point)

Use at least 20 different permanently installed products from at least five different manufacturers that have publicly released a report from their raw material suppliers which include raw material supplier extraction locations, a commitment to long-term ecologically responsible land use, a commitment to reducing environmental harms from extraction and/or manufacturing processes, and a commitment to meeting applicable standards or programs voluntarily that address responsible sourcing criteria

- Products sourced from manufacturers with self-declared reports are valued as one half (1/2) of a product for credit achievement.
- Third-party verified corporate sustainability reports (CSR) which include environmental impacts of extraction operations and activities associated with the manufacturer's product and the product's supply chain, are valued as one whole product for credit achievement calculation. Acceptable CSR frameworks include the following:
 - **Global Reporting Initiative (GRI) Sustainability Report**
 - **Organisation for Economic Co-operation and Development (OECD) Guidelines for Multinational Enterprises**
 - **U.N. Global Compact: Communication of Progress**
 - **ISO 26000: 2010 Guidance on Social Responsibility**
 - **USGBC approved program:** Other USGBC approved programs meeting the CSR criteria.

Option 2. Leadership Extraction Practices (1 point)

Use products that meet at least one of the responsible extraction criteria below for at least 25%, by cost, of the total value of permanently installed building products in the project.

- *Extended producer responsibility.* Products purchased from a manufacturer (producer) that participates in an extended producer responsibility program or is directly responsible for extended
- *Bio-based materials.* Bio-based products must meet the Sustainable Agriculture Network's Sustainable Agriculture Standard. Bio-based raw materials must be tested using ASTM Test Method D6866 and be legally harvested, as defined by the exporting and receiving country. Exclude hide products, such as leather and other animal skin material. Products meeting bio-based materials criteria are valued at 100% of their cost for the purposes of credit achievement calculation.
- *Wood products.* Wood products must be certified by the Forest Stewardship Council or USGBC-approved equivalent. Products meeting wood products criteria are valued at 100% of their cost for the purposes of credit achievement calculation.
- *Materials reuse.* Reuse includes salvaged, refurbished, or reused products. Products meeting materials reuse criteria are valued at 100% of their cost for the purposes of credit achievement calculation.
- *Recycled content.* Recycled content is the sum of postconsumer recycled content plus one-half the preconsumer recycled content, based on cost. Products meeting recycled content criteria are valued at 100% of their cost for the purposes of credit achievement calculation
- *USGBC approved program.* Other USGBC approved programs meeting leadership extraction criteria.

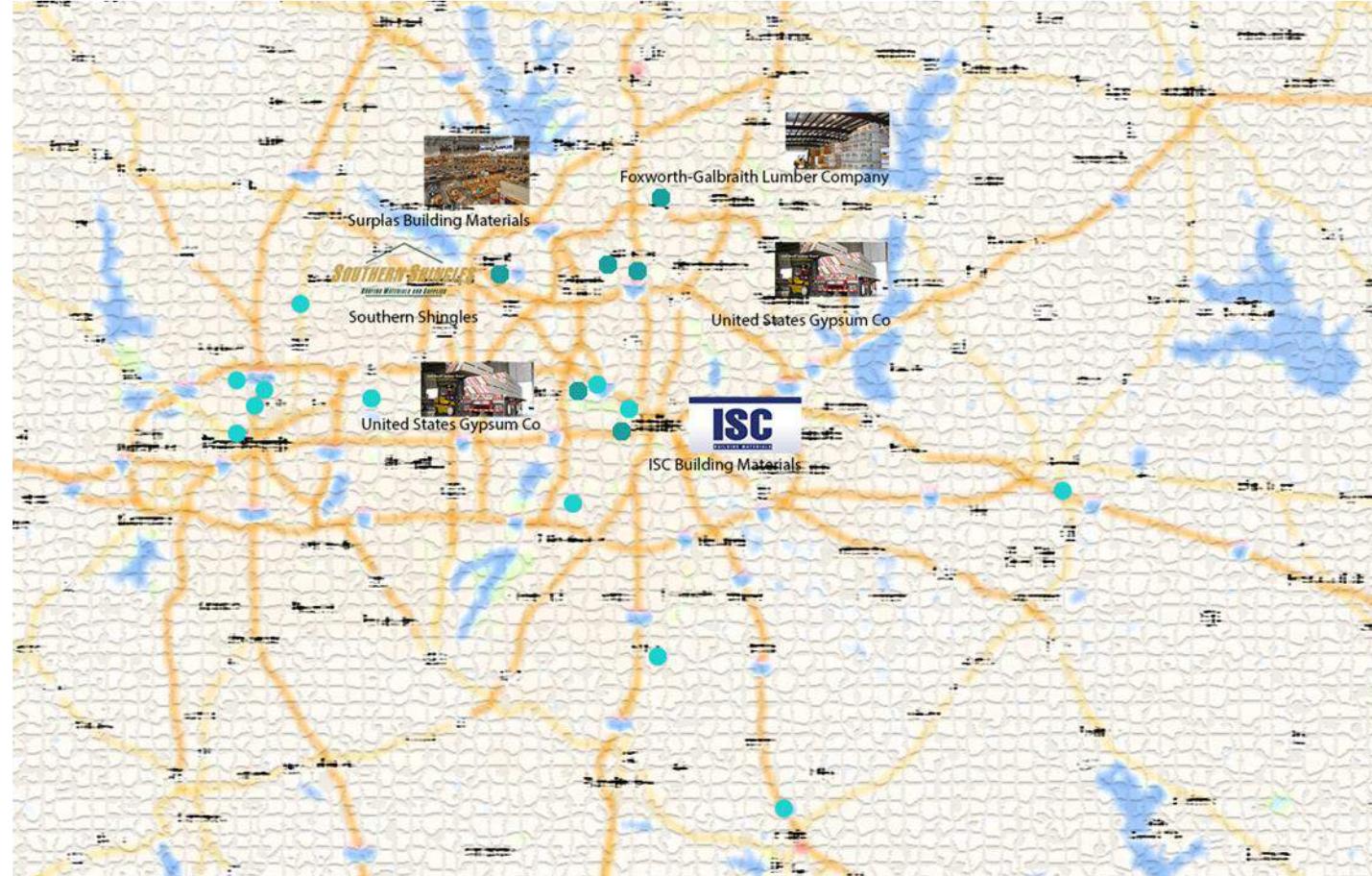
For credit achievement calculation, products sourced (extracted, manufactured and purchased) within 100 miles (160 km) of the project site are valued at 200% of their base contributing cost. For credit achievement calculation, the base contributing cost of individual products compliant with multiple responsible extraction criteria is not permitted to exceed 100% its total actual cost (before regional multipliers) and double counting of single product components compliant with multiple responsible extraction criteria is not permitted and in no case is a product permitted to contribute more than 200% of its total actual cost.



The mark of
responsible forestry



The manufactures near Dallas City are shown in fig 23 and the one within a 100 mile distance are highlighted



MR CREDIT: BUILDING PRODUCT DISCLOSURE AND OPTIMIZATION – MATERIAL INGREDIENTS

BD&C

1-2 points

This credit applies to

- New Construction (1-2 points)
- Core & Shell (1-2 points)
- Schools (1-2 points)
- Retail (1-2 points)
- Data Centers (1-2 points)
- Warehouses & Distribution Centers (1-2 points)
- Hospitality (1-2 points)
- Healthcare (1-2 points)

Intent

To encourage the use of products and materials for which life-cycle information is available and that have environmentally, economically, and socially preferable life-cycle impacts. To reward project teams for selecting products for which the chemical ingredients in the product are inventoried using an accepted methodology and for selecting products verified to minimize the use and generation of harmful substances. To reward raw material manufacturers who produce products verified to have improved life-cycle impacts.

Use at least 20 different permanently installed products from at least five different manufacturers that use any of the following programs to demonstrate the chemical inventory of the product to at least 0.1% (1000 ppm).

- *Manufacturer Inventory.* The manufacturer has published complete content inventory for the product following these guidelines:
 - A publicly available inventory of all ingredients identified by name and Chemical Abstract Service Registration Number (CASRN)
 - Materials defined as trade secret or intellectual property may withhold the name and/or CASRN but must disclose role, amount and GreenScreen benchmark, as defined in GreenScreen v1.2.
- *Health Product Declaration.* The end use product has a published, complete Health Product Declaration with full disclosure of known hazards in compliance with the Health Product Declaration open Standard.
- **Cradle to Cradle.** The end use product has been certified at the Cradle to Cradle v2 Basic level or Cradle to Cradle v3 Bronze level.
- *USGBC approved program.* Other USGBC approved programs meeting the material ingredient reporting criteria.

Here is a brief overview of the different stages of cradle to cradle marking point and their requirements:

Cradle to cradle materials apply to each and every material used in a building, from an adhesive glue for plywood to bricks used in façade.

Flooring adhesives

XL BRANDS /PRODUCTS /REGISTRY /SEARCH&P_COMPANY=XL-BRANDS



Renewal date 18 January 2017

Manufacturer Description

XL Brands Flooring Adhesive is a luxury vinyl flooring adhesive.



(get-certifiedlevels /silver3_0)

Boral Bricks

BORAL BRICKS, INC. /PRODUCTS /REGISTRY /SEARCH&P_COMPANY=BORAL_BRICKS_INC



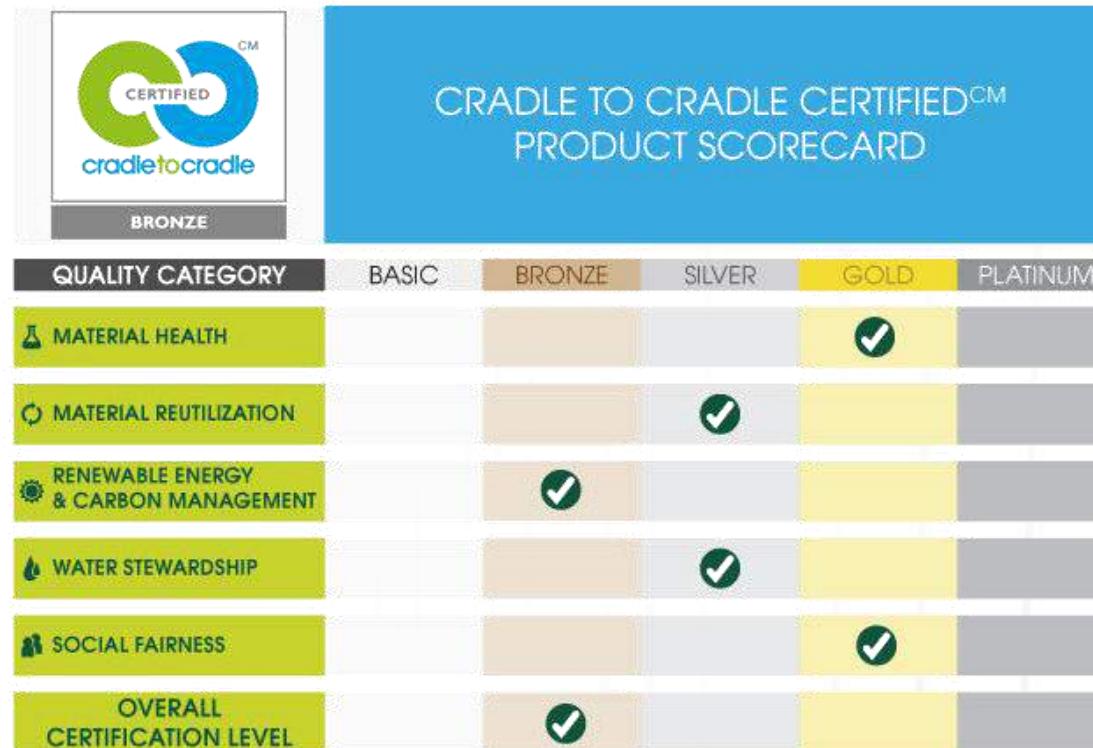
Renewal date 10 January 2014 – Pending Recertification

Manufacturer Description

Boral Bricks are available in a wide variety of shapes, colors and textures. Boral® Shapes include curved edges, detailed silhouettes, and angled faces to add architectural detail and drama to a home. Boral Bricks carry a limited "Transferable Residential Warranty" that can be passed on to a new owner with the sale of a home.



(get-certifiedlevels /silver2_11)



MR CREDIT: CONSTRUCTION AND DEMOLITION WASTE MANAGEMENT

BD&C

1–2 points

This credit applies to

- New Construction (1–2 points)
- Core & Shell (1–2 points)
- Schools (1–2 points)
- Retail (1–2 points)
- Data Centers (1–2 points)
- Warehouses & Distribution Centers (1–2 points)
- Hospitality (1–2 points)
- Healthcare (1–2 points)

Intent

To reduce construction and demolition waste disposed of in landfills and incineration facilities by recovering, reusing, and recycling materials.

Recycle and/or salvage nonhazardous construction and demolition materials. Calculations can be by weight or volume but must be consistent throughout.

Exclude excavated soil, land-clearing debris, and alternative daily cover (ADC). Include wood waste converted to fuel (biofuel) in the calculations; other types of waste-to-energy are not considered diversion for this credit.

However, for projects that cannot meet credit requirements using reuse and recycling methods, waste-to-energy systems may be considered waste diversion if the European Commission Waste Framework Directive 2008/98/EC and Waste Incineration Directive 2000/76/EC are followed and Waste to Energy facilities meet applicable European Committee for Standardization (CEN) EN 303 standards.

Option 1. Diversion (1–2 points)

Path 1. Divert 50% and Three Material Streams (1 point)

Divert at least 50% of the total construction and demolition material; diverted materials must include at least three material streams.

OR

Path 2. Divert 75% and Four Material Streams (2 points)

Divert at least 75% of the total construction and demolition material; diverted materials must include at least four material streams.

OR

Option 2. Reduction of Total Waste Material (2 points)

Do not generate more than 2.5 pounds of construction waste per square foot (12.2 kilograms of waste per square meter) of the building's floor area.

Here are some strategies derived from “EPA Measure of Success, Calculating Waste Reduction”

table which can prevent the waste surplus

Although some of them only apply to offices, other ones can be applied to the residential building as well

WasteWise Update

8

TABLE 2: How Can I Collect Data for Specific Activities & Materials?

| Sample Activities/Materials | Sample Data Collection Methods |
|---|--|
| Waste Prevention Encourage employees to reduce paper. Communicate with employees and customers using e-mail. Replace paper manuals with online manuals. Reuse office supplies. Lightweight packaging. Switch to reusable containers. Work with suppliers to reduce waste from inbound shipments. Replace disposable cafeteria items with reusable ones. Donate materials. Compost on site. Reduce waste in a particular department. | <ul style="list-style-type: none">Survey employees about how much paper they are using before and after the start of a paper reduction program.Study paper purchasing records. See Calculation 2, page 10 for a sample calculation.Study paper purchasing records.Track copier and fax machine counters.Survey employees.Estimate weight of old manual and multiply by the number of employees to which it would usually be distributed.Survey employees.Estimate weight of reused office supplies using the table of default weights below.Examine packaging supply invoices (multiply boxes supplied by the reduction in weight per box).Examine past and present packaging supply invoices. Work with a reusable container vendor to determine number of times containers can be reused before disposal. See Calculation 1, page 9 for a sample calculation.Write into contracts that vendors must detail packaging specifications on invoices.Look at cafeteria purchasing records or invoices.Conduct pilot test to monitor cafeteria consumer behavior over a given time period.Work with cafeteria contractor to obtain cafeteria product usage figures.Examine donation receipts.Estimate weight using volume-to-weight conversions for yard trimmings listed at <www.epa.gov/epaoswer/non-hw/recycle/recmeas/conversn.htm>.Direct a waste sort, or a series of waste sorts, at the particular department. |
| Recycling Collection Collect more recyclables. | <ul style="list-style-type: none">Review hauler records for data on volumes and tonnages of recyclables collected.Estimate total volume of recycling bins and track frequency of collection. See the EPA Recycling Measurement home page at <www.epa.gov/epaoswer/non-hw/recycle/recmeas/>. Convert volume collected to weight using conversion factors listed at <www.epa.gov/epaoswer/non-hw/recycle/recmeas/conversn.htm>. |
| Buying Products With Recycled Content Increase percentage of recycled content in products purchased. | <ul style="list-style-type: none">Work with vendors to track percentages of recycled content, particularly post-consumer recycled content, on their invoices.Add a column to current purchasing records to include percentage of recycled content. |
| Increase the quantity and types of purchases containing recycled materials. | <ul style="list-style-type: none">Work with vendors to find recycled-content products and indicate quantity and weight of the products on invoices.Look at purchasing records to determine the dollar amount spent on recycled-content products. |

EQ CREDIT: ENHANCED INDOOR AIR QUALITY STRATEGIES

BD&C

1–2 points

This credit applies to

- New Construction (1–2 points)
- Core & Shell (1–2 points)
- Schools (1–2 points)
- Retail (1–2 points)
- Data Centers (1–2 points)
- Warehouses & Distribution Centers (1–2 points)
- Hospitality (1–2 points)
- Healthcare (1–2 points)

Intent

To promote occupants' comfort, well-being, and productivity by improving indoor air quality.

Comply with the following requirements, as applicable.

Mechanically ventilated spaces:

- A. entryway systems;
- B. interior cross-contamination prevention; and
- C. filtration.

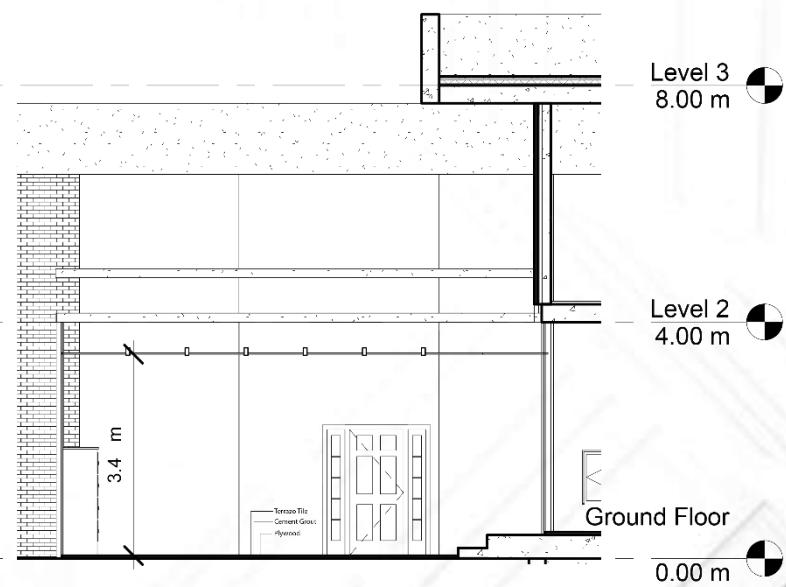
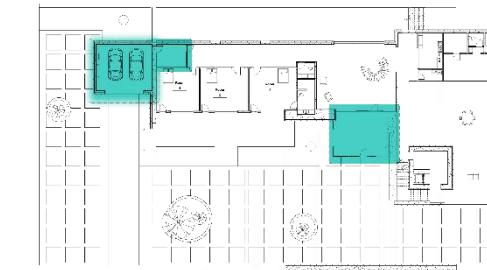
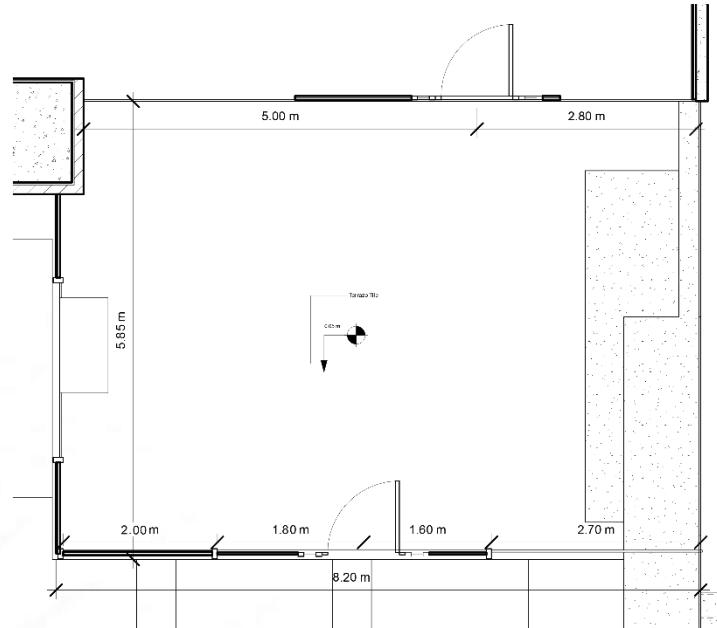
Naturally ventilated spaces:

- A. entryway systems; and
- D. natural ventilation design calculations.

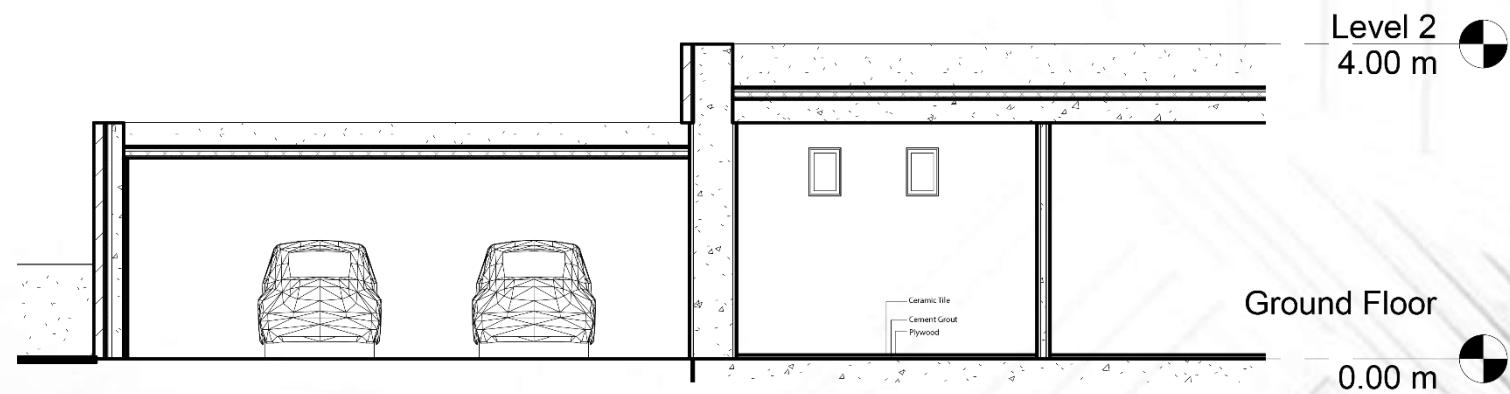
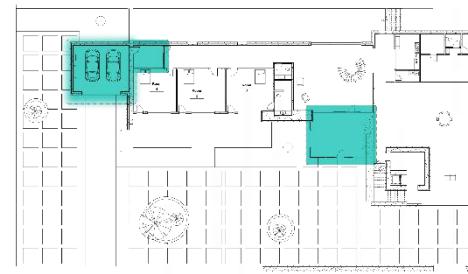
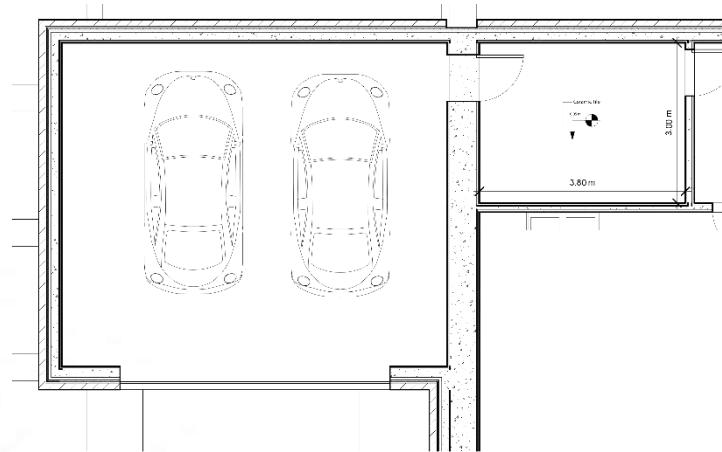
Mixed-mode systems:

- A. entryway systems;
- B. interior cross-contamination prevention;
- C. filtration;
- D. natural ventilation design calculations; and
- E. mixed-mode design calculations.

The Entryway system in order to achieve the criteria's for IAQ goals must be long enough (at least 10 feet) to capture the dirt when one is entering the building, it also helps to moderate the exterior weather condition before reaching in, thus preventing from any extreme temperature change



When a space like garage is attached to the building, it needs a vestibule with a proper ventilation system working as a filter in order to reduce the gas or chemicals that may be present system before reaching to the main building, a room.



EQ CREDIT: LOW-EMITTING MATERIALS

BD&C

1–3 points

This credit applies to

- New Construction (1–3 points)
- Core & Shell (1–3 points)
- Schools (1–3 points)
- Retail (1–3 points)
- Data Centers (1–3 points)
- Warehouses & Distribution Centers (1–3 points)
- Hospitality (1–3 points)
- Healthcare (1–3 points)

Intent

To reduce concentrations of chemical contaminants that can damage air quality, human health, productivity, and the environment.

This credit includes requirements for product manufacturing as well as project teams. It covers volatile organic compound (VOC) emissions into indoor air and the VOC content of materials, as well as the testing methods by which indoor VOC emissions are determined. Different materials must meet different requirements to be considered compliant for this credit. The building interior and exterior are organized in seven categories, each with different thresholds of compliance. The building interior is defined as everything within the waterproofing membrane. The building exterior is defined as everything outside and inclusive of the primary and secondary weatherproofing system, such as waterproofing membranes and air- and water-resistive barrier materials.

BEES

- Different kind of weights for each impact
- Environmental/ Economic Performance
- Choosing the Building Element for Case Study

The screenshot shows the BEES online software interface. At the top, there is a logo featuring a bee on a hexagonal honeycomb with the text "BEES online". To the right, it says "Life Cycle Analysis for Building Products". Below the logo, there are navigation links: "Home", "Analysis", and "Help".

The main area is titled "ANALYSIS PARAMETERS" and includes the following sections:

- Environmental Impact Category Weights:** A table showing weights for various impacts:

| Impact | Weight |
|-------------------------|--------|
| Global Warming | 16 |
| Acidification | 5 |
| Eutrophication | 5 |
| Fossil Fuel Depletion | 5 |
| Indoor Air Quality | 11 |
| Habitat Alteration | 16 |
| Water Intake | 3 |
| Criteria Air Pollutants | 6 |
| Smog | 6 |
| Ecotoxicity | 11 |
| Ozone Depletion | 5 |
| Human Health | 11 |
| Sum: | 100 |
- Performance Weights:** Fields for "Environmental Performance (%)" (set to 100) and "Economic Performance (%)" (set to 0).
- Discount Rate(%) (Excluding Inflation):** A field set to 2.7.
- Building Element for Comparison:** Selection dropdowns for Major Group Element (Building Maintenance), Group Element (Cleaning Products), and Individual Element (Bath and Tile Cleaners). There is also a link to "View Product List".
- Next Step:** A button labeled "Next" with the instruction "Click the Next button to select product alternatives."

- As shown in the chart above, in the BEES stakeholder Panel, there is a significant tendency to the global warming while the human health is less than important in this panel, which may be caused by the fact that global warming is more noticeable to them than the human health issues.
- The EPA panel, on the other hand, spread the values equally among all the factors.

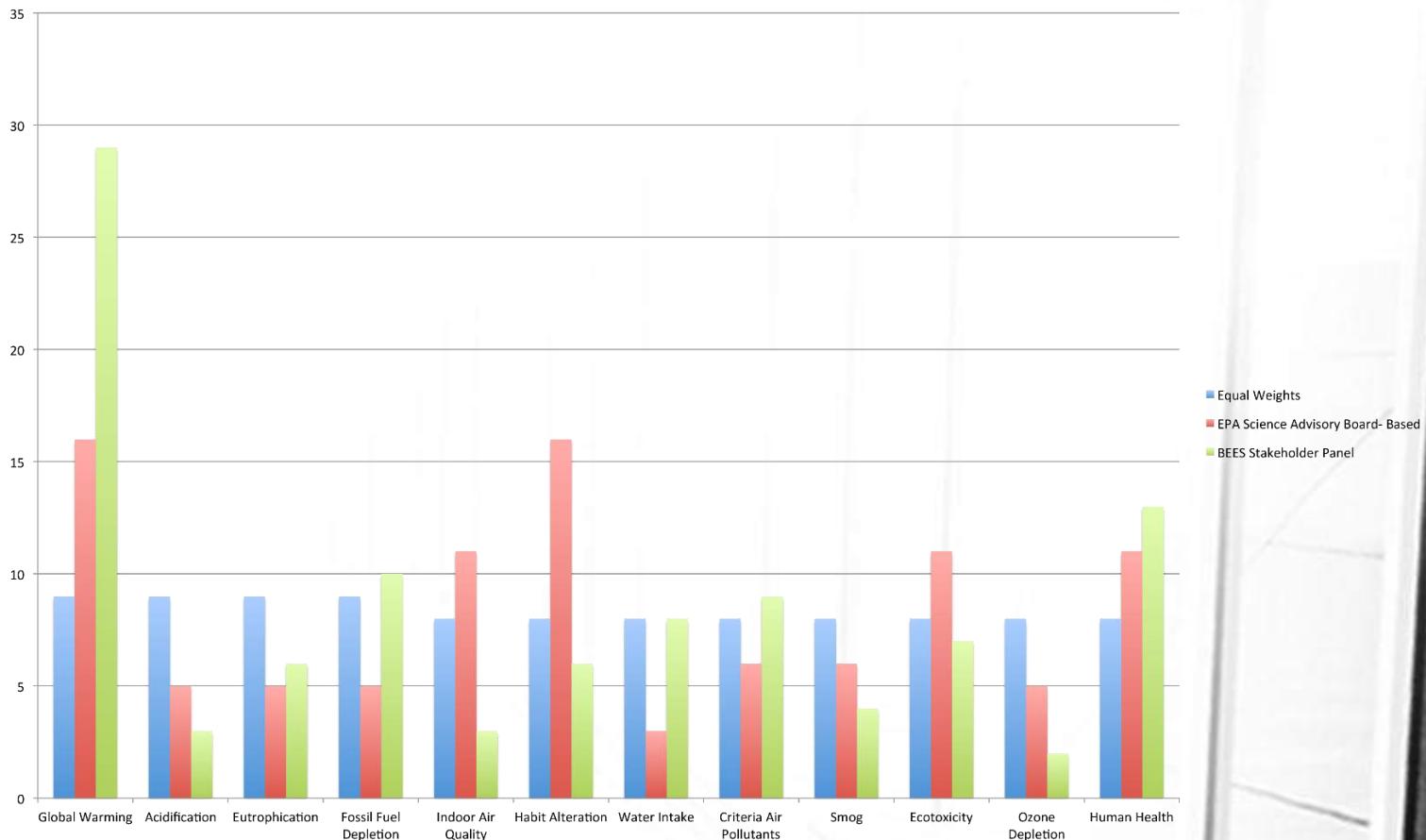
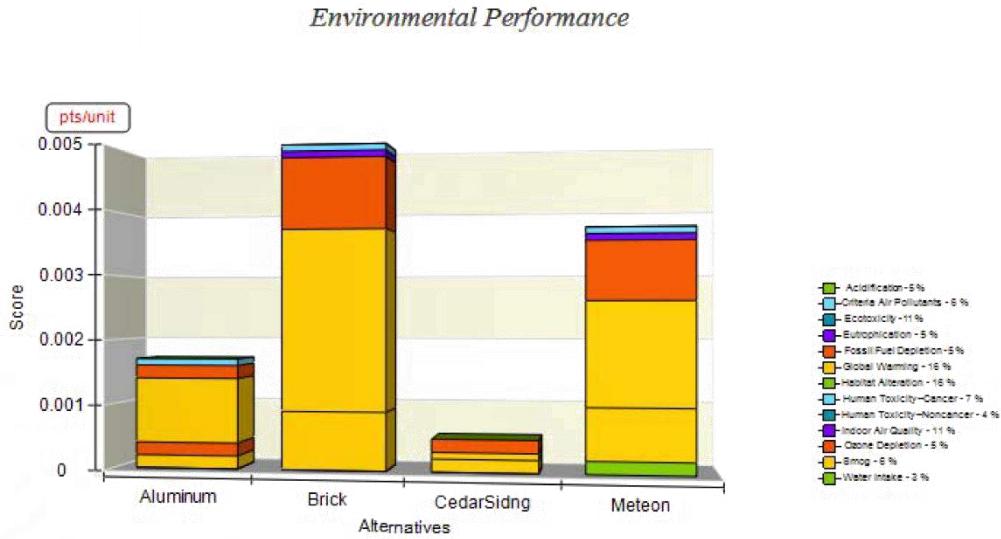


Fig 22: The value of different impacts

- Summary Graphs
- Life-Cycle Stage Graphs
- Environmental Flow Graphs
- Embodied Energy Graphs

Environmental Performance

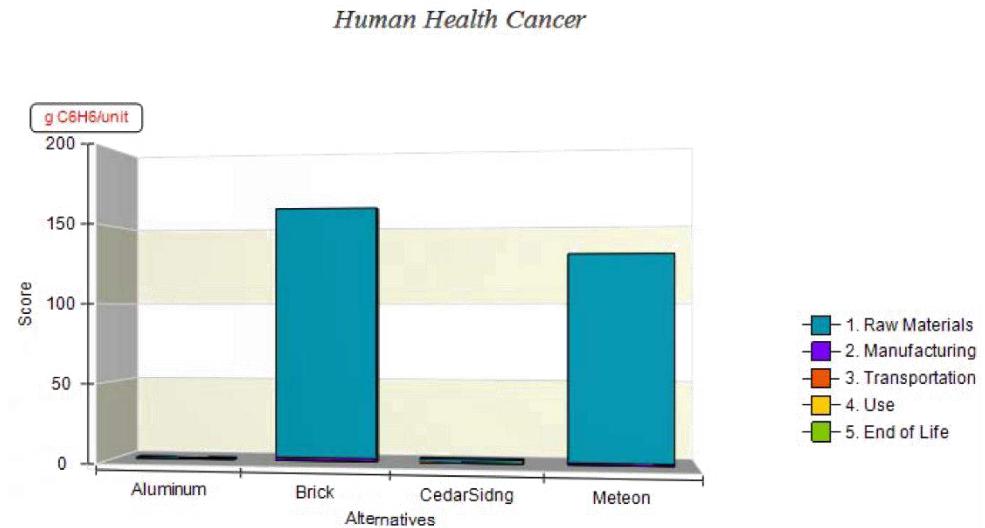


Due to the traditional process of manufacturing brick, the process makes a lot of harm in the global warming factor. Meteon which is used in this project can be a tread to the global warming, while Cedar Siding seems to be safe in every aspect.

| Category | Aluminum | Brick | CedarSiding | Meteon |
|--------------------------------|----------|--------|-------------|--------|
| Acidification - 5 % | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| Criteria Air Pollutants - 6 % | 0.0001 | 0.0001 | 0.0000 | 0.0001 |
| Ecotoxicity - 11 % | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| Eutrophication - 5 % | 0.0000 | 0.0001 | 0.0000 | 0.0001 |
| Fossil Fuel Depletion - 5 % | 0.0002 | 0.0011 | 0.0002 | 0.0009 |
| Global Warming - 16 % | 0.0010 | 0.0028 | 0.0001 | 0.0016 |
| Habitat Alteration - 16 % | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| Human Toxicity–Cancer - 7 % | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| Human Toxicity–Noncancer - 4 % | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| Indoor Air Quality - 11 % | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| Ozone Depletion - 5 % | 0.0002 | 0.0000 | 0.0000 | 0.0000 |
| Smog - 6 % | 0.0002 | 0.0009 | 0.0002 | 0.0008 |
| Water Intake - 3 % | 0.0000 | 0.0000 | 0.0000 | 0.0002 |
| Sum | 0.0017 | 0.0050 | 0.0005 | 0.0037 |

- Summary Graphs
- Life-Cycle Stage Graphs
- Environmental Flow Graphs
- Embodied Energy Graphs

Human Health Cancer

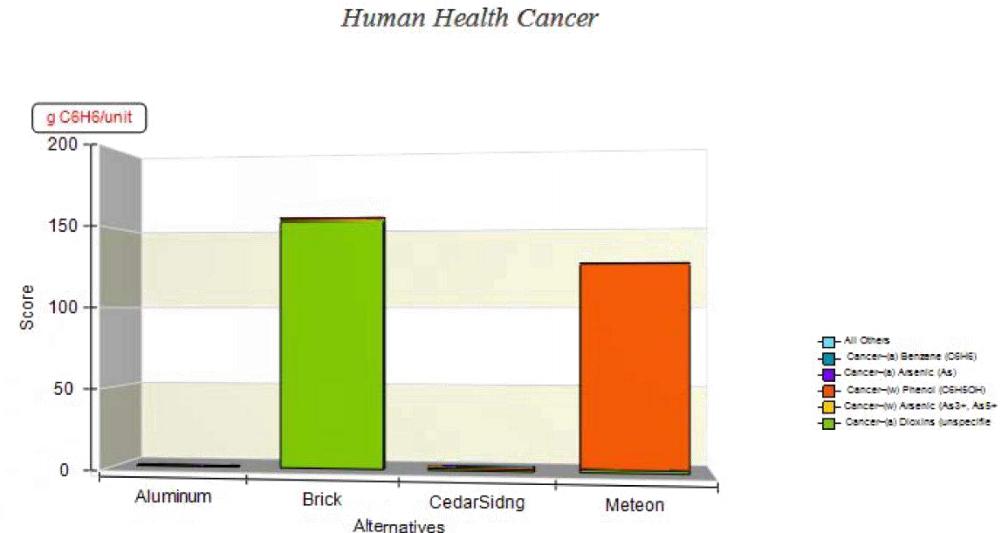


While none of this materials has a high number for human cancer in the part of “use. The high chance in raw material section for Brick, following by Meteon suggest thread to the workers who excavate and process the raw material for this substances.

| Category | Aluminum | Brick | CedarSiding | Meteon |
|-------------------|----------|----------|-------------|----------|
| 1. Raw Materials | 0.6028 | 158.6761 | 1.8041 | 129.6719 |
| 2. Manufacturing | 0.1197 | 1.5323 | 0.0000 | 1.1510 |
| 3. Transportation | 0.0060 | 0.4869 | 0.0417 | 0.1608 |
| 4. Use | 0.0000 | 0.0000 | 0.6156 | 0.0000 |
| 5. End of Life | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| Sum | 0.7285 | 160.6953 | 2.4614 | 130.9837 |

- Summary Graphs
- Life-Cycle Stage Graphs
- Environmental Flow Graphs
- Embodied Energy Graphs

Human Health Cancer

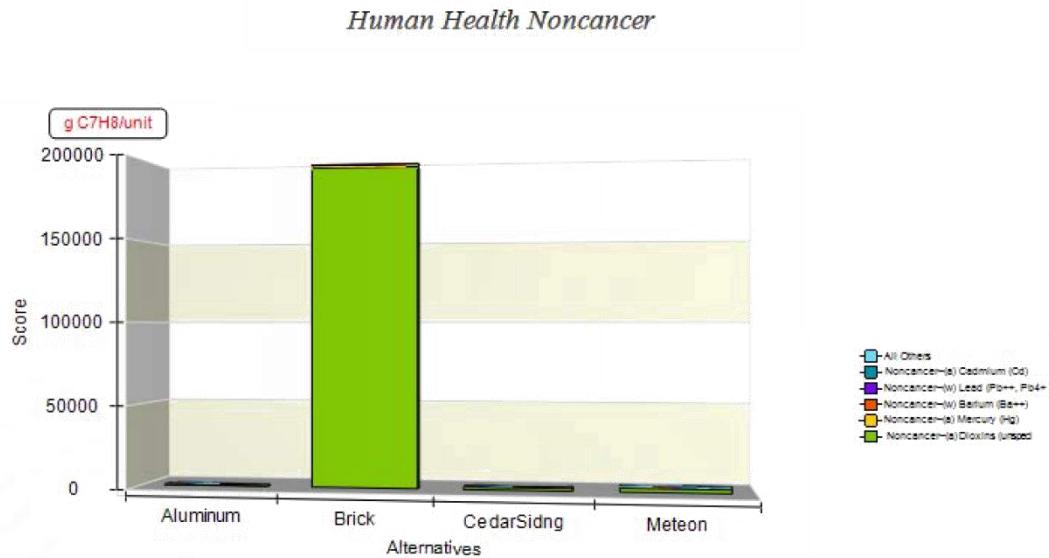


While brick and meteon are the only substances in this comparison which emit cancer substances, meteon has a significant amount of Phenol, a hazardous material named by EPA which makes it much more dangerous than brick

| Category | Aluminum | Brick | CedarSiding | Meteon |
|---|----------|----------|-------------|----------|
| All Others | 0.0128 | 0.0258 | 0.0603 | 0.2666 |
| Cancer-(a) Arsenic (As) | 0.1043 | 0.1987 | 0.0915 | 0.2663 |
| Cancer-(a) Benzene (C ₆ H ₆) | 0.0105 | 0.0642 | 0.0097 | 0.0881 |
| Cancer-(a) Dioxins (unspecifie) | 0.2003 | 153.4737 | 1.2364 | 1.7593 |
| Cancer-(w) Arsenic (As ³⁺ , As ⁵⁺) | 0.1945 | 0.8545 | 0.1964 | 0.3940 |
| Cancer-(w) Phenol (C ₆ H ₅ OH) | 0.1821 | 0.7984 | 0.7862 | 123.9055 |
| Sum | 0.7045 | 155.4153 | 2.3805 | 126.6798 |

- Summary Graphs
- Life-Cycle Stage Graphs
- Environmental Flow Graphs
- Embodied Energy Graphs

Human Health Noncancer

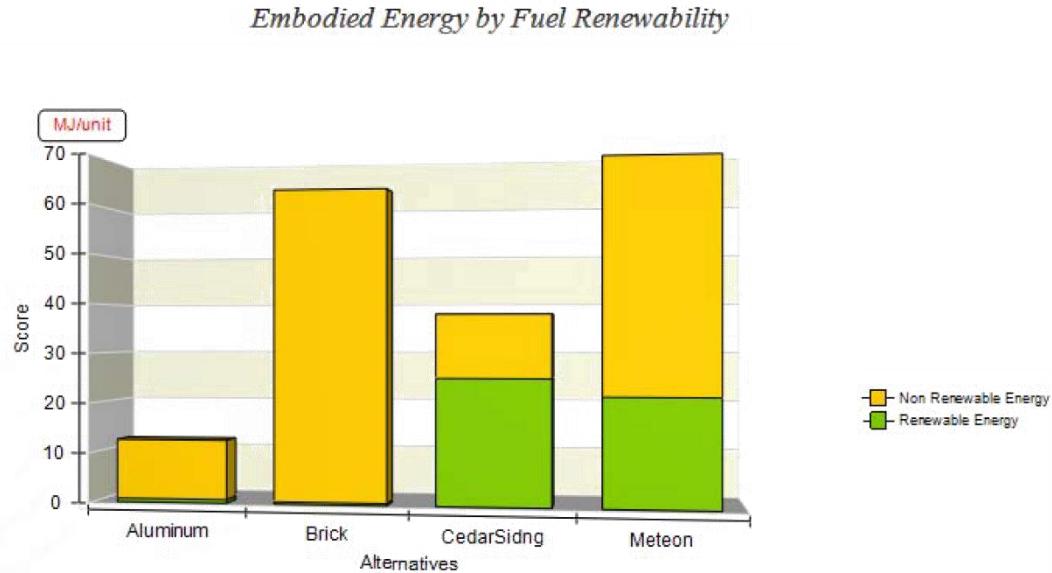


The dioxin caused by brick is significantly high, while other materials are in the safe zone in this category. Dioxin is the only high element in the human health cancer and non cancer category, which means brick is safe to the residents living in the house and it is dangerous to the workers who produce this material.

| Category | Aluminum | Brick | CedarSiding | Meteon |
|---------------------------------|-----------|-------------|-------------|-----------|
| All Others | 258.1695 | 310.2273 | 228.7198 | 459.6845 |
| Noncancer-(a) Cadmium (Cd) | 37.1144 | 122.4779 | 35.4600 | 147.2978 |
| Noncancer-(a) Dioxins (unspec) | 252.2947 | 193353.6690 | 1557.6669 | 2216.4736 |
| Noncancer-(a) Mercury (Hg) | 414.1900 | 998.3203 | 139.9944 | 403.9463 |
| Noncancer-(w) Barium (Ba++) | 89.4194 | 308.7574 | 108.5443 | 130.1522 |
| Noncancer-(w) Lead (Pb++, Pb4+) | 47.4504 | 192.9806 | 58.3760 | 81.7586 |
| Sum | 1098.6384 | 195286.4325 | 2128.7614 | 3439.3130 |

- Summary Graphs
- Life-Cycle Stage Graphs
- Environmental Flow Graphs
- Embodied Energy Graphs

Embodied Energy by Fuel Renewability



While meteon has the most amount of embodied energy in total, brick has the most amount of non renewable embodied energy which points out that brick makes the most harm to environment, Most of the embodied energy for cedar siding in renewable.

| Category | Aluminum | Brick | CedarSiding | Meteon |
|----------------------|----------|---------|-------------|---------|
| Non Renewable Energy | 11.8752 | 62.1118 | 12.6252 | 46.6450 |
| Renewable Energy | 0.7238 | 0.4368 | 25.1507 | 21.6880 |
| Sum | 12.5990 | 62.5486 | 37.7759 | 68.3330 |

EQ CREDIT: CONSTRUCTION INDOOR AIR QUALITY MANAGEMENT PLAN

BD&C

1 point

This credit applies to

- New Construction (1 point)
- Core & Shell (1 point)
- Schools (1 point)
- Retail (1 point)
- Data Centers (1 point)
- Warehouses & Distribution Centers (1 point)
- Hospitality (1 point)
- Healthcare (1 point)

Intent

To promote the well-being of construction workers and building occupants by minimizing indoor air quality problems associated with construction and renovation.

Develop and implement an indoor air quality (IAQ) management plan for the construction and preoccupancy phases of the building. The plan must address all of the following.

During construction, meet or exceed all applicable recommended control measures of the Sheet Metal and Air Conditioning National Contractors Association (SMACNA) IAQ Guidelines for Occupied Buildings under Construction, 2nd edition, 2007, ANSI/SMACNA 008–2008, Chapter 3.

Protect absorptive materials stored on-site and installed from moisture damage.

Do not operate permanently installed air-handling equipment during construction unless filtration media with a minimum efficiency reporting value (MERV) of 8, as determined by ASHRAE 52.2–2007, with errata (or equivalent filtration media class of F5 or higher, as defined by CEN Standard EN 779–2002, Particulate Air Filters for General Ventilation, Determination of the Filtration Performance), are installed at each return air grille and return or transfer duct inlet opening such that there is no bypass around the filtration media. Immediately before occupancy, replace all filtration media with the final design filtration media, installed in accordance with the manufacturer's recommendations.

Prohibit the use of tobacco products inside the building and within 25 feet (7.5 meters) of the building entrance during construction.

EQ CREDIT: INDOOR AIR QUALITY ASSESSMENT

BD&C

1–2 points

This credit applies to

- New Construction (1–2 points)
- Schools (1–2 points)
- Retail (1–2 points)
- Data Centers (1–2 points)
- Warehouses & Distribution Centers (1–2 points)
- Hospitality (1–2 points)
- Healthcare (1–2 points)

Intent

To establish better quality indoor air in the building after construction and during occupancy.

Path 1. Before Occupancy

Install new filtration media and perform a building flush-out by supplying a total air volume of 14,000 cubic feet of outdoor air per square foot (4 267 140 liters of outdoor air per square meter) of gross floor area while maintaining an internal temperature of at least 60°F (15°C) and no higher than 80°F (27°C) and relative humidity no higher than 60%.

OR

Path 2. During Occupancy

If occupancy is desired before the flush-out is completed, the space may be occupied only after delivery of a minimum of 3,500 cubic feet of outdoor air per square foot (1 066 260 liters of outdoor air per square meter) of gross floor area while maintaining an internal temperature of at least 60°F (15°C) and no higher than 80°F (27°C) and relative humidity no higher than 60%..

Once the space is occupied, it must be ventilated at a minimum rate of 0.30 cubic foot per minute (cfm) per square foot of outdoor air (1.5 liters per second per square meter of outside air) or the design minimum outdoor air rate determined in EQ Prerequisite Minimum Indoor Air Quality Performance, whichever is greater. During each day of the flush-out period, ventilation must begin at least three hours before occupancy and continue during occupancy. These conditions must be maintained until a total of 14,000 cubic feet per square foot of outdoor air (4 270 liters of outdoor air per square meter) has been delivered to the space.

EQ CREDIT: THERMAL COMFORT

BD&C
1 point

This credit applies to

- New Construction (1 point)
- Schools (1 point)
- Retail (1 point)
- Data Centers (1 point)
- Warehouses & Distribution Centers (1 point)
- Hospitality (1 point)
- Healthcare (1 point)

Intent

To promote occupants' productivity, comfort, and well-being by providing quality thermal comfort.

Requirements

Meet the requirements for both thermal comfort design and thermal comfort control.

Option 1. ASHRAE Standard 55-2010

Design heating, ventilating, and air-conditioning (HVAC) systems and the building envelope to meet the requirements of ASHRAE Standard 55-2010, Thermal Comfort Conditions for Human Occupancy with errata or a local equivalent.

For natatoriums, demonstrate compliance with ASHRAE HVAC Applications Handbook, 2011 edition, Chapter 5, Places of Assembly, Typical Natatorium Design Conditions, with errata.

OR

Option 2. ISO and CEN Standards

Design HVAC systems and the building envelope to meet the requirements of the applicable standard:

- ISO 7730:2005, Ergonomics of the Thermal Environment, analytical determination and interpretation of thermal comfort, using calculation of the PMV and PPD indices and local thermal comfort criteria; and
- CEN Standard EN 15251:2007, Indoor Environmental Input Parameters for Design and Assessment of Energy Performance of Buildings, addressing indoor air quality, thermal environment, lighting, and acoustics, Section A2.

EQ CREDIT: INTERIOR LIGHTING

BD&C
1–2 points

This credit applies to

- New Construction (1–2 points)
- Schools (1–2 points)
- Retail (2 points)
- Data Centers (1–2 points)
- Warehouses & Distribution Centers (1–2 points)
- Hospitality (1–2 points)
- Healthcare (1 point)

Intent

To promote occupants' productivity, comfort, and well-being by providing high-quality lighting.

Option 1. Lighting Control (1 point)

For at least 90% of individual occupant spaces, provide individual lighting controls that enable occupants to adjust the lighting to suit their individual tasks and preferences, with at least three lighting levels or scenes (on, off, midlevel). Midlevel is 30% to 70% of the maximum illumination level (not including daylight contributions).

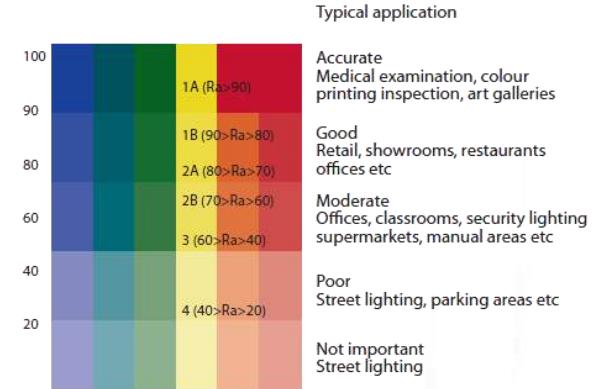
For all shared multioccupant spaces, meet all of the following requirements.

- Have in place multizone control systems that enable occupants to adjust the lighting to meet group needs and preferences, with at least three lighting levels or scenes (on, off, midlevel).
- Lighting for any presentation or projection wall must be separately controlled.
- Switches or manual controls must be located in the same space as the controlled luminaires. A person operating the controls must have a direct line of sight to the controlled luminaires.

Choose four of the following strategies.

- A. For all regularly occupied spaces, use light fixtures with a luminance of less than 2,500 cd/m² between 45 and 90 degrees from nadir.
Exceptions include wallwash fixtures properly aimed at walls, as specified by manufacturer's data, indirect uplighting fixtures, provided there is no view down into these uplights from a regularly occupied space above, and any other specific applications (i.e. adjustable fixtures).
- B. For the entire project, use light sources with a CRI of 80 or higher. Exceptions include lamps or fixtures specifically designed to provide colored lighting for effect, site lighting, or other special use.
- C. For at least 75% of the total connected lighting load, use light sources that have a rated life (or L70 for LED sources) of at least 24,000 hours (at 3-hour per start, if applicable).
- D. Use direct-only overhead lighting for 25% or less of the total connected lighting load for all regularly occupied spaces.
- E. For at least 90% of the regularly occupied floor area, meet or exceed the following thresholds for area-weighted average surface reflectance: 85% for ceilings, 60% for walls, and 25% for floors.
- F. If furniture is included in the scope of work, select furniture finishes to meet or exceed the following thresholds for area-weighted average surface reflectance: 45% for work surfaces, and 50% for movable partitions.
- G. For at least 75% of the regularly occupied floor area, meet a ratio of average wall surface illuminance (excluding fenestration) to average work plane (or surface, if defined) illuminance that does not exceed 1:10. Must also meet strategy E, strategy F, or demonstrate area-weighted surface reflectance of at least 60% for walls.
- H. For at least 75% of the regularly occupied floor area, meet a ratio of average ceiling illuminance (excluding fenestration) to work surface illuminance that does not exceed 1:10. Must also meet strategy E, strategy F, or demonstrate area-weighted surface reflectance of at least 85% for ceilings.

A color rendering index (CRI) is a quantitative measure of the ability of a light source to reveal the colors of various objects faithfully in comparison with an ideal or natural light source.



A dimmer switch helps us to have the amount of luminance we need in our room for different activities.



Fig 23: A spectrum of the dimmer light

EQ CREDIT: DAYLIGHT

BD&C

1–3 points

This credit applies to

- New Construction (1–3 points)
- Core & Shell (1–3 points)
- Schools (1–3 points)
- Retail (1–3 points)
- Data Centers (1–3 points)
- Warehouses & Distribution Centers (1–3 points)
- Hospitality (1–3 points)
- Healthcare (1–2 points)

Intent

To connect building occupants with the outdoors, reinforce circadian rhythms, and reduce the use of electrical lighting by introducing daylight into the space.

Option 1. **Simulation:** Spatial Daylight Autonomy and Annual Sunlight Exposure (2–3 points, 1–2 points Healthcare)

Demonstrate through annual computer simulations that spatial daylight autonomy_{300/50%} (sDA_{300/50%}) of at least 55%, 75%, or 90% is achieved. Use regularly occupied floor area. Healthcare projects should use the perimeter area determined under EQ Credit Quality Views. Points are awarded according to Table 1.

Table 1. Points for daylit floor area: Spatial daylight autonomy

| New Construction, Core and Shell, Schools, Retail, Data Centers, Warehouses and Distribution Centers, Hospitality | | Healthcare | |
|---|--------|--------------------------------|--------|
| sDA (for regularly occupied floor area) | Points | sDA (for perimeter floor area) | Points |
| 55% | 2 | 75% | 1 |
| 75% | 3 | 90% | 2 |

As Shown in Fig 24 & 25, the mixture of shadow and light has create a pleasant ambient in the house without the existence of any problematic glare. The needed amount of foot candle for the daily activities is met by the natural light, therefore the dependent of artificial light becomes minimum.

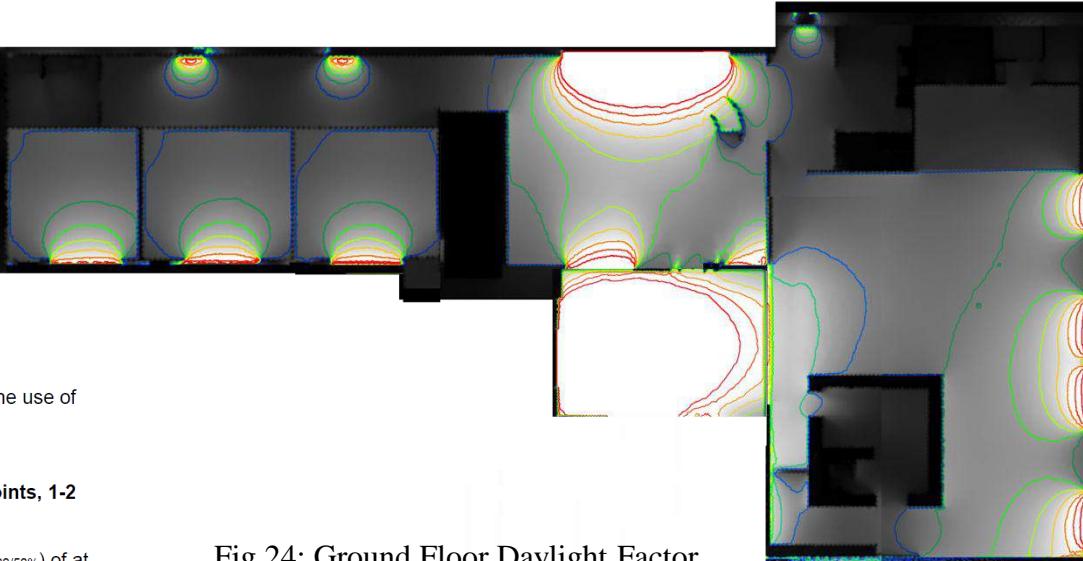


Fig 24: Ground Floor Daylight Factor

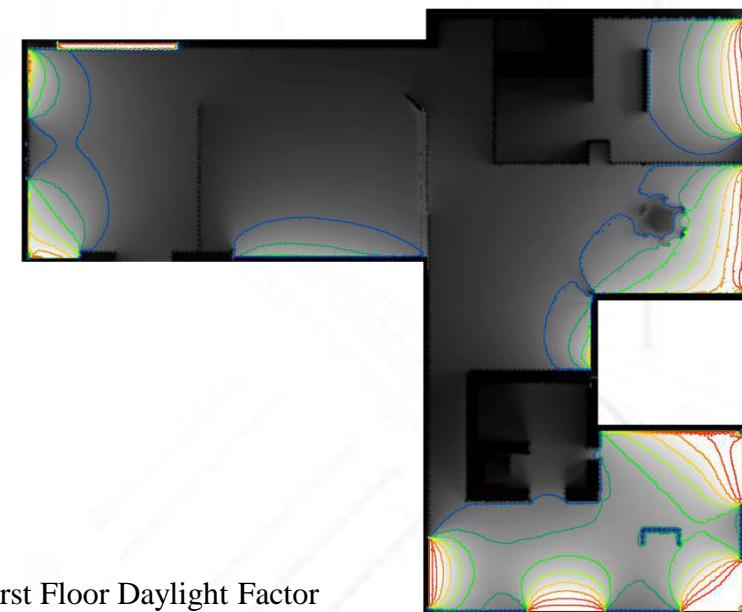


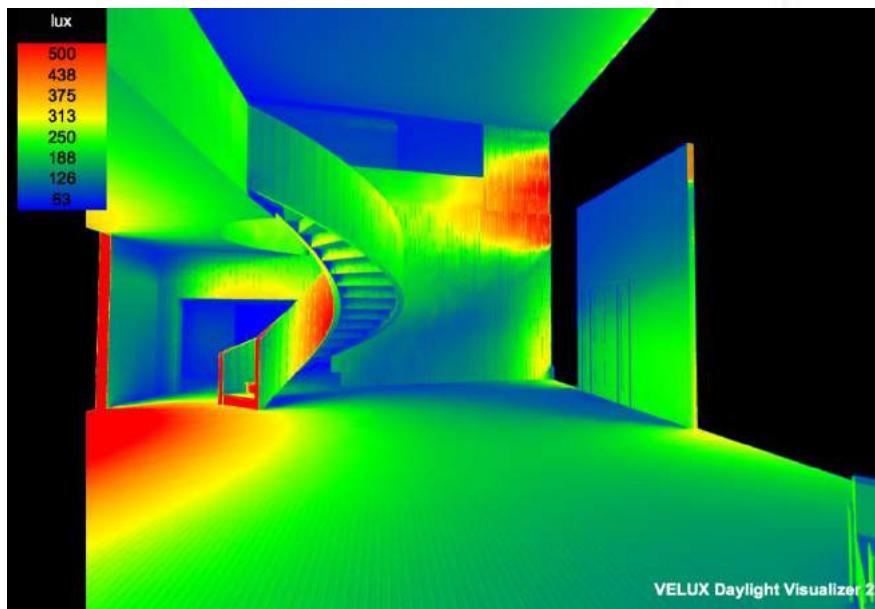
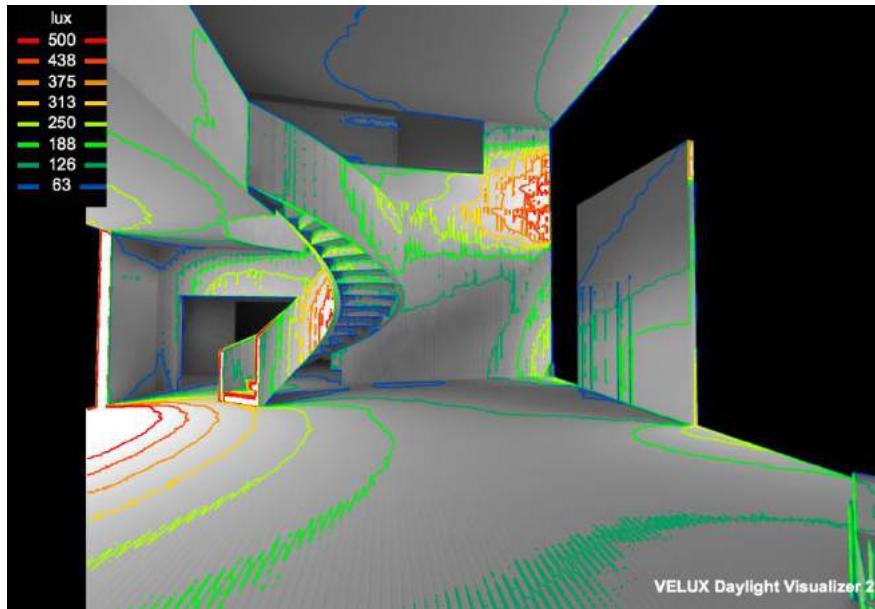
Fig 25: First Floor Daylight Factor

The Main Hall:

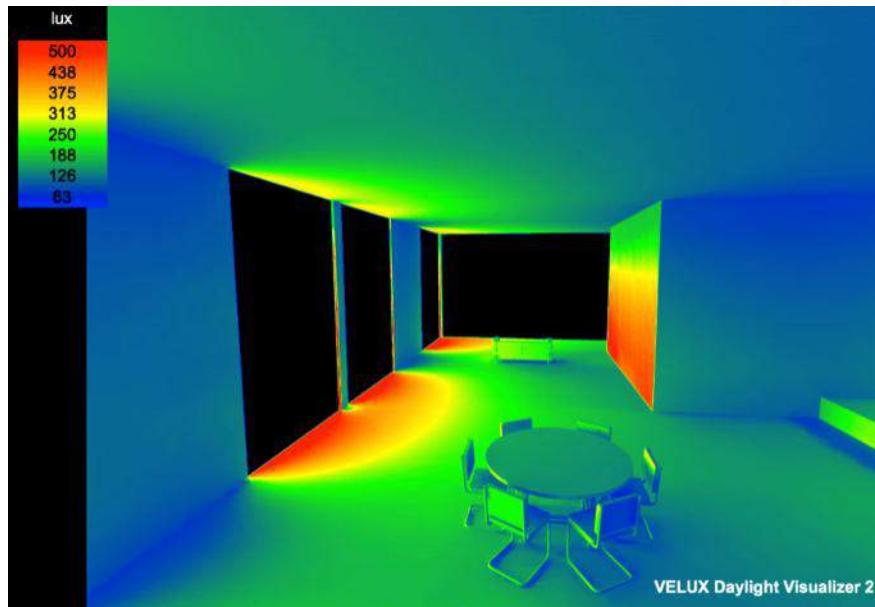
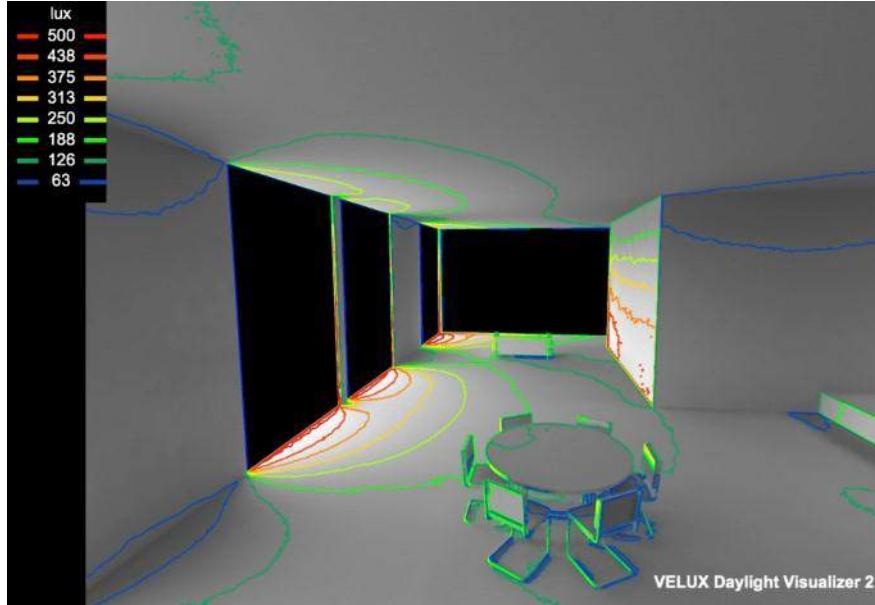
The amount of natural light being conceived is in the range of 250 lux, which is acceptable for the main activities that occurs in a main hall.

Designing a long East- West axis lobby will improve the natural lighting in a building.

The natural light spread through the space, making the whole lobby act as a whole is caused by the right and the dialectical portion of windows and glazing area in the walls,



Due to the overhangs which are designed all around the envelope, the luminance needed for the building can be provided by using storefront walls in the building and not having problems such as unwanted heat gain or glare.



EQ CREDIT: ACOUSTIC PERFORMANCE

BD&C

1–2 points

This credit applies to

- New Construction (1 point)
- Schools (1 point)
- Data Centers (1 point)
- Warehouses & Distribution Centers (1 point)
- Hospitality (1 point)
- Healthcare (1–2 points)

Intent

To provide workspaces and classrooms that promote occupants' well-being, productivity, and communications through effective acoustic design.

HVAC Background Noise

Achieve maximum background noise levels from heating, ventilating, and air conditioning (HVAC) systems per 2011 ASHRAE Handbook, HVAC Applications, Chapter 48, Table 1; AHRI Standard 885-2008, Table 15; or a local equivalent. Calculate or measure sound levels.

For measurements, use a sound level meter that conforms to ANSI S1.4 for type 1 (precision) or type 2 (general purpose) sound measurement instrumentation, or a local equivalent.

Comply with design criteria for HVAC noise levels resulting from the sound transmission paths listed in ASHRAE 2011 Applications Handbook, Table 6; or a local equivalent.

Sound Transmission

Meet the composite sound transmission class (STC_c) ratings listed in Table 1, or local building code, whichever is more stringent.

Table 1. Minimum composite sound transmission class ratings for adjacent spaces

| Adjacency combinations | | STC _c |
|---|--------------------------------|------------------|
| Residence (within a multifamily residence), hotel or motel room | Residence, hotel or motel room | 55 |
| Residence, hotel or motel room | Common hallway, stairway | 50 |
| Residence, hotel or motel room | Retail | 60 |
| Retail | Retail | 50 |
| Standard office | Standard office | 45 |
| Executive office | Executive office | 50 |
| Conference room | Conference room | 50 |
| Office, conference room | Hallway, stairway | 50 |
| Mechanical equipment room | Occupied area | 60 |

EQ CREDIT: QUALITY VIEWS

BD&C

1-2 points

This credit applies to

- New Construction (1 point)
- Core & Shell (1 point)
- Schools (1 point)
- Retail (1 point)
- Data Centers (1 point)
- Warehouses & Distribution Centers (1 point)
- Hospitality (1 point)
- Healthcare (1-2 points)

Intent

To give building occupants a connection to the natural outdoor environment by providing quality views.

NC, CS, SCHOOLS, RETAIL, DATA CENTERS, HOSPITALITY

Achieve a direct line of sight to the outdoors via vision glazing for 75% of all regularly occupied floor area. View glazing in the contributing area must provide a clear image of the exterior, not obstructed by frits, fibers, patterned glazing, or added tints that distort color balance.

Additionally, 75% of all regularly occupied floor area must have at least two of the following four kinds of views:

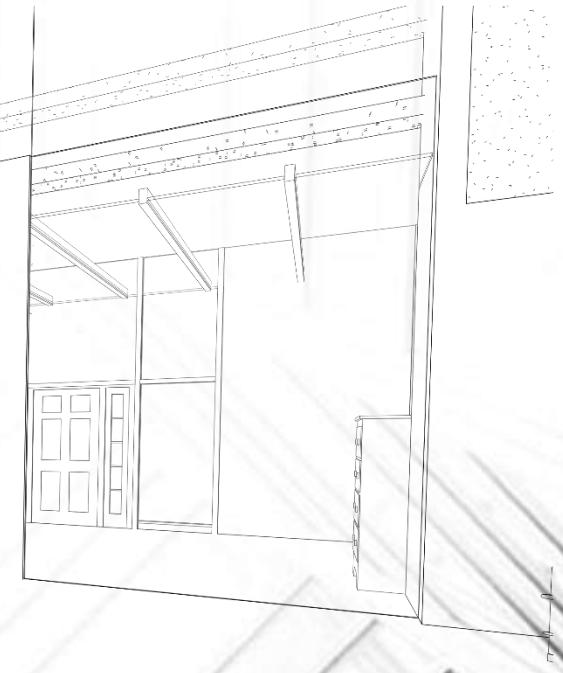
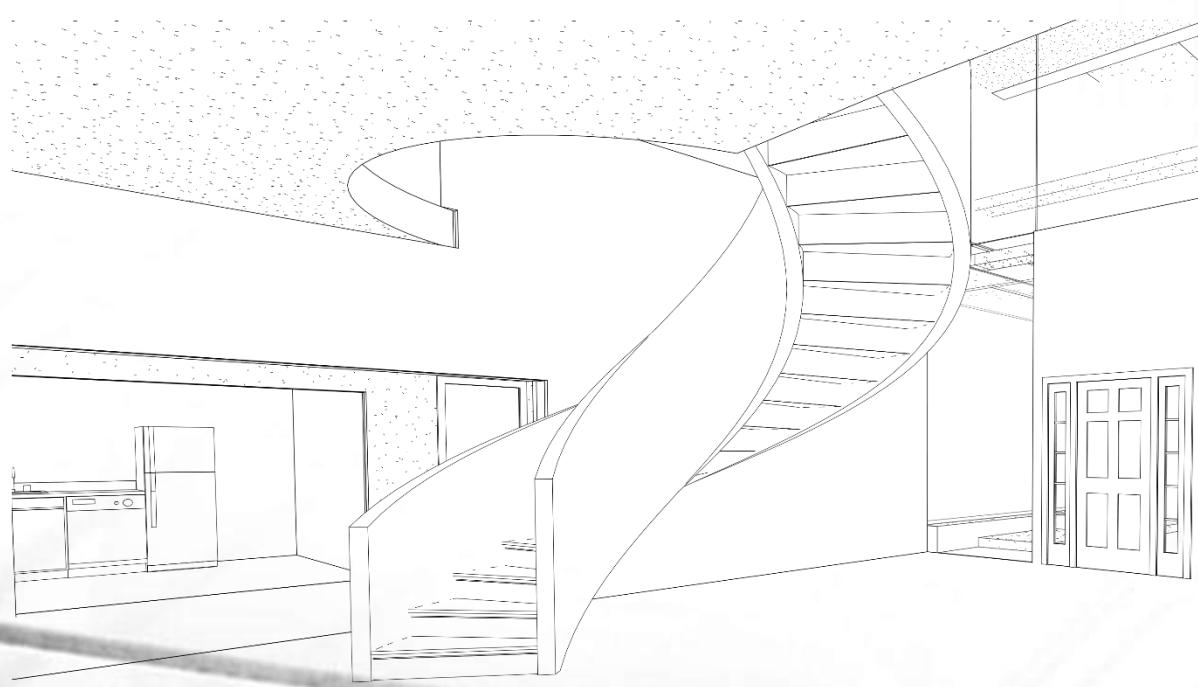
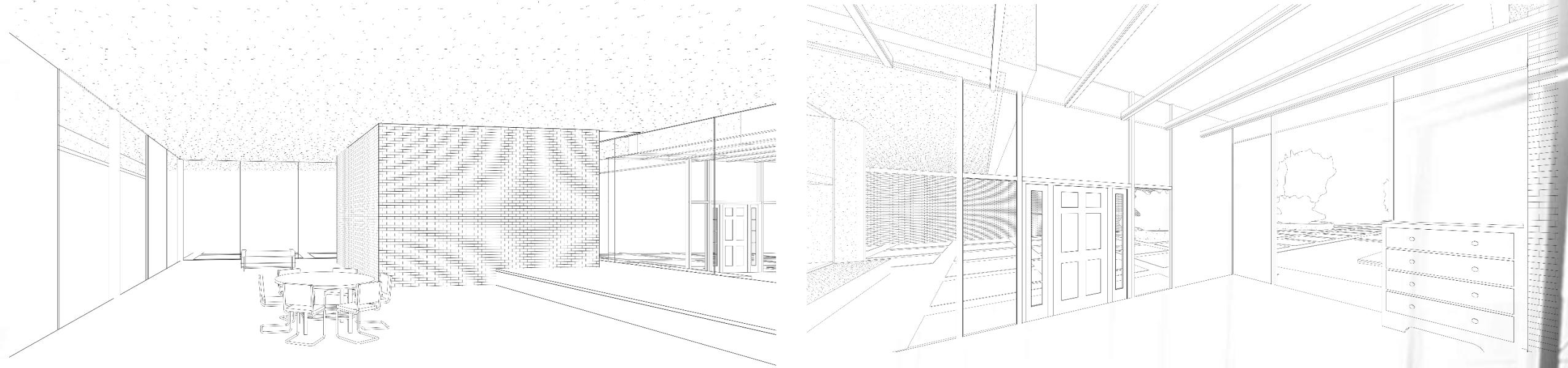
- multiple lines of sight to vision glazing in different directions at least 90 degrees apart;
- views that include at least two of the following: (1) flora, fauna, or sky; (2) movement; and (3) objects at least 25 feet (7.5 meters) from the exterior of the glazing;
- unobstructed views located within the distance of three times the head height of the vision glazing; and
- views with a view factor of 3 or greater, as defined in "Windows and Offices; A Study of Office Worker Performance and the Indoor Environment."

Include in the calculations any permanent interior obstructions. Movable furniture and partitions may be excluded.

Views into interior atria may be used to meet up to 30% of the required area.



Some of the views are shown as example:



REGIONAL PRIORITY (RP)



RP CREDIT: REGIONAL PRIORITY

BD&C

4 points

This credit applies to

- New Construction (1-4 points)
- Core & Shell (1-4 points)
- Schools (1-4 points)
- Retail (1-4 points)
- Data Centers (1-4 points)
- Warehouses & Distribution Centers (1-4 points)
- Hospitality (1-4 points)
- Healthcare (1-4 points)

Intent

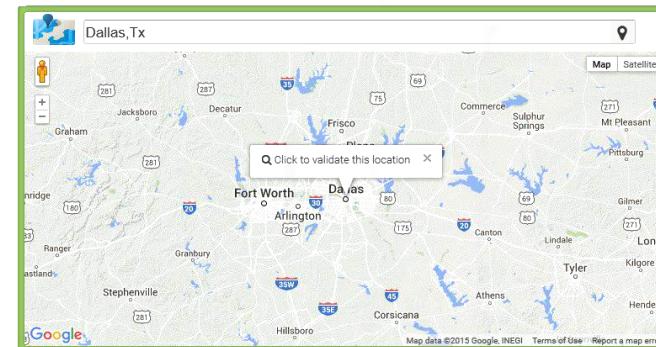
To provide an incentive for the achievement of credits that address geographically specific environmental, social equity, and public health priorities.

Earn up to four of the six Regional Priority credits. These credits have been identified by the USGBC regional councils and chapters as having additional regional importance for the project's region. A database of Regional Priority credits and their geographic applicability is available on the USGBC website, <http://www.usgbc.org>.

If a project team attempts a credit for which there is a RP point available, a symbol will appear in the RP column of the LEED Online Scorecard. It will appear gray, and once earned, it will turn orange. Remember that although six RP credits are available and may appear available in the LEED Online Scorecard, the project team can earn only four.

Regional priority credit lookup

FILTER LEED BD+C: New Construction v4



Renewable energy production

Up to 3 points
Required Point Threshold: 2

Optimize energy performance

Up to 18 points
Required Point Threshold: 7

Enhanced indoor air quality strategies

Up to 2 points
Required Point Threshold: 2

Reduced parking footprint

1 point
Required Point Threshold: 1

Rainwater management

Up to 3 points
Required Point Threshold: 2

Outdoor water use reduction

Up to 2 points
Required Point Threshold: 1



LEED v4 for BD+C: New Construction and Major Renovation

Project Checklist

Project Name: Dune Villa
Date: 12/5/2015

Y ? N
1 Credit Integrative Process

1

| 14 | 0 | 2 | Location and Transportation | 16 |
|----|---|---|---|----|
| | | | Credit LEED for Neighborhood Development Location | 16 |
| 1 | | | Credit Sensitive Land Protection | 1 |
| | | 2 | Credit High Priority Site | 2 |
| 5 | | | Credit Surrounding Density and Diverse Uses | 5 |
| 5 | | | Credit Access to Quality Transit | 5 |
| 1 | | | Credit Bicycle Facilities | 1 |
| 1 | | | Credit Reduced Parking Footprint | 1 |
| 1 | | | Credit Green Vehicles | 1 |

| 12 | 0 | 1 | Materials and Resources | 13 |
|----|---|---|--|----------|
| | | | Prereq Storage and Collection of Recyclables | Required |
| Y | | | Prereq Construction and Demolition Waste Management Planning | Required |
| Y | | | Credit Building Life-Cycle Impact Reduction | 5 |
| 4 | | 1 | Credit Building Product Disclosure and Optimization - Environmental Product Declarations | 2 |
| 2 | | | Credit Building Product Disclosure and Optimization - Sourcing of Raw Materials | 2 |
| 2 | | | Credit Building Product Disclosure and Optimization - Material Ingredients | 2 |
| 2 | | | Credit Construction and Demolition Waste Management | 2 |

| 10 | 0 | 0 | Sustainable Sites | 10 |
|----|---|---|--|----------|
| Y | | | Prereq Construction Activity Pollution Prevention | Required |
| 1 | | | Credit Site Assessment | 1 |
| 2 | | | Credit Site Development - Protect or Restore Habitat | 2 |
| 1 | | | Credit Open Space | 1 |
| 3 | | | Credit Rainwater Management | 3 |
| 2 | | | Credit Heat Island Reduction | 2 |
| 1 | | | Credit Light Pollution Reduction | 1 |

| 16 | 0 | 0 | Indoor Environmental Quality | 16 |
|----|---|---|--|----------|
| Y | | | Prereq Minimum Indoor Air Quality Performance | Required |
| Y | | | Prereq Environmental Tobacco Smoke Control | Required |
| 2 | | | Credit Enhanced Indoor Air Quality Strategies | 2 |
| 3 | | | Credit Low-Emitting Materials | 3 |
| 1 | | | Credit Construction Indoor Air Quality Management Plan | 1 |
| 2 | | | Credit Indoor Air Quality Assessment | 2 |
| 1 | | | Credit Thermal Comfort | 1 |
| 2 | | | Credit Interior Lighting | 2 |
| 3 | | | Credit Daylight | 3 |
| 1 | | | Credit Quality Views | 1 |
| 1 | | | Credit Acoustic Performance | 1 |

| 9 | 0 | 2 | Water Efficiency | 11 |
|---|---|---|--------------------------------------|----------|
| Y | | | Prereq Outdoor Water Use Reduction | Required |
| Y | | | Prereq Indoor Water Use Reduction | Required |
| Y | | | Prereq Building-Level Water Metering | Required |
| 2 | | | Credit Outdoor Water Use Reduction | 2 |
| 6 | | | Credit Indoor Water Use Reduction | 6 |
| | | 2 | Credit Cooling Tower Water Use | 2 |
| 1 | | | Credit Water Metering | 1 |

| 1 | 0 | 5 | Innovation | 6 |
|---|---|---|-------------------------------------|---|
| | | 5 | Credit Innovation | 5 |
| | | 1 | Credit LEED Accredited Professional | 1 |

| 33 | 0 | 0 | Energy and Atmosphere | 33 |
|----|---|---|---|----------|
| Y | | | Prereq Fundamental Commissioning and Verification | Required |
| Y | | | Prereq Minimum Energy Performance | Required |
| Y | | | Prereq Building-Level Energy Metering | Required |
| Y | | | Prereq Fundamental Refrigerant Management | Required |
| 6 | | | Credit Enhanced Commissioning | 6 |
| 18 | | | Credit Optimize Energy Performance | 18 |
| 1 | | | Credit Advanced Energy Metering | 1 |
| 2 | | | Credit Demand Response | 2 |
| 3 | | | Credit Renewable Energy Production | 3 |
| 1 | | | Credit Enhanced Refrigerant Management | 1 |
| 2 | | | Credit Green Power and Carbon Offsets | 2 |

| 98 | 0 | 12 | TOTALS | Possible Points: 110 |
|---|---|----|--------|----------------------|
| Certified: 40 to 49 points, Silver: 50 to 59 points, Gold: 60 to 79 points, Platinum: 80 to 110 | | | | |

Natural ventilation is one of the most crucial needs of a design in warm, humid climates like Dallas, it keeps the building dry which prevents the mold to grow, which count as hazardous substances to peoples health. By orienting the building to the right angle and designing openings in the right place and proper size in order to cause a ventilation, we can benefit from the wind in this places to have a natural ventilation . Having opening at both sides is needed to have a ventilation , you can't have a ventilation by just having windows on one side of your building. Another factor is that the path of the wind should not be blocks with any kind of barriers as much as possible

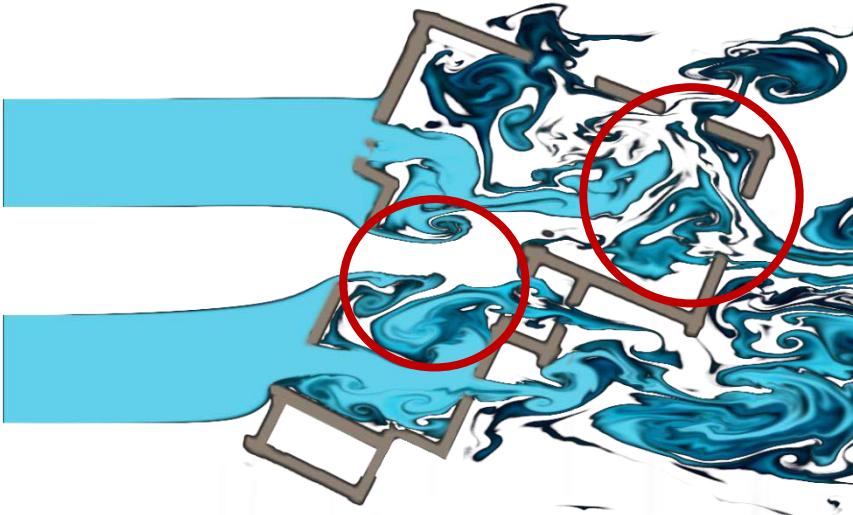


Fig 27: Natural ventilation simulation –Plan

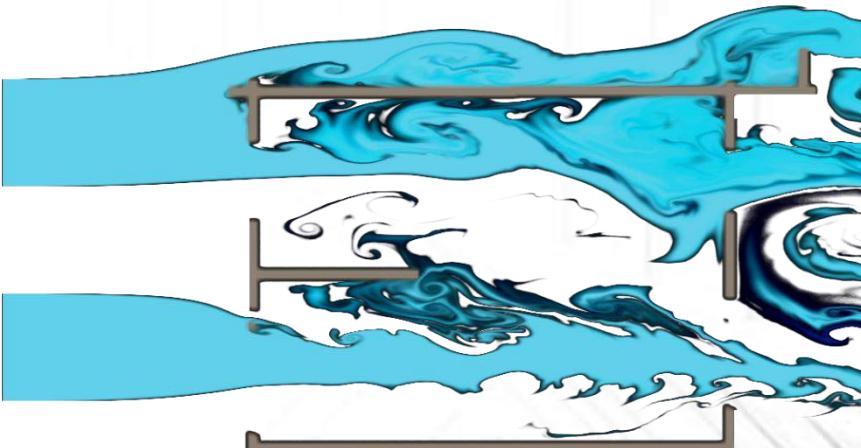


Fig 27: Natural ventilation simulation –Section of the main hall

The screenshot shows the REScheck-Web software interface for a project titled "Duna 2009 IECC". The main menu includes PROJECT, ENVELOPE, MECHANICAL, and REQUIREMENTS tabs. The ENVELOPE tab is active, displaying a table of building envelope components. The table has columns for Component, Assembly, Gross Area, Cavity Insulation R-Value, Continuous Insulation R-Value, U-Factor, and SNCC. One row is selected for a wall assembly with the following values: Gross Area 167 ft², Cavity Insulation R-Value 9.3, Continuous Insulation R-Value 1.8, U-Factor 0.093, and SNCC listed.

The screenshot shows the REScheck-Web software interface with a modal dialog box titled "Update Wall". The dialog lists various wall assembly options with radio buttons. The "Solid Concrete or Masonry w/ Exterior Insul" option is selected. Other options include Wood Frame, 16" o.c., Wood Frame, 24" o.c., Steel Frame, 16" o.c., Steel Frame, 24" o.c., Masonry Block w/ Empty Cells, Masonry Block w/ Integral Insulation, Structural Insulated Panels, Insulated Concrete Forms, and Other. At the bottom of the dialog are "» Update Wall" and "Cancel" buttons.

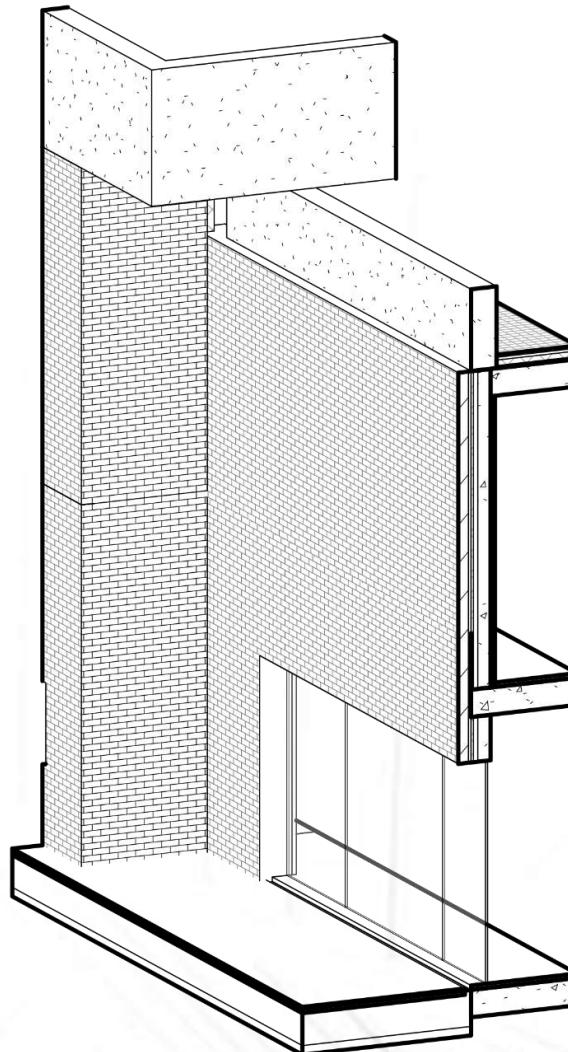
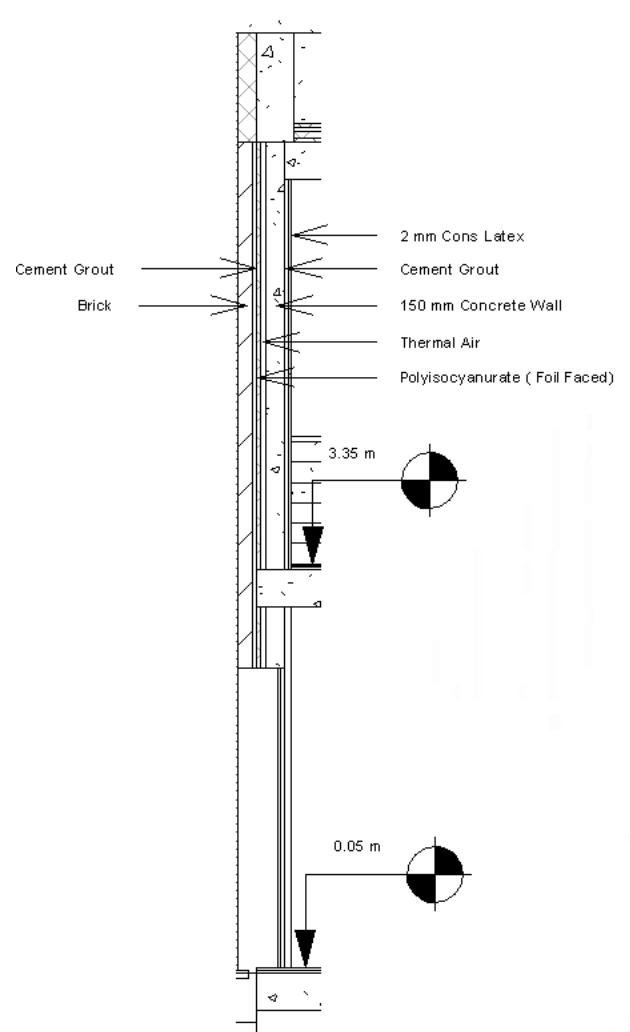
The wall system used in this building is solid concrete as the core, followed by exterior insulation, which results in high cavity and continuous insulation.

High R- value of a building envelope is a crucial part of the building process in warm and humid climates like Dallas, as it would minimize the energy transfer between the interior and outside.

Thermal resistance or “R” value indicates how much effective any material is as an insulator. The definition of this variable is the hours needed for 1 BTU to flow through 1ft² of given material.

Where materials are sandwiched together, perpendicular to the direction of the heat flow, the Total “R” value would be the result of adding each “R” value from every material in series.

$$R_t = 1.11 + 7.2 + 1 + 4.8 = 14.11$$



REScheck-Web™

Dura
2009 IECC

Email Address Password [Log In](#)
[Register](#) | [Forgot Password?](#)

[New Project](#) [PROJECT](#) [ENVELOPE](#) [MECHANICAL](#) [REQUIREMENTS](#) [Reports](#)

Row: [Edit](#) [Duplicate](#) [Move Up](#) [Move Down](#) [Delete](#)

Add: [Ceiling](#) [Skylight](#) [Wall](#) [Window](#) [Door](#) [Basement](#) [Floor](#) [Crawl](#)

| Component | Assembly | Gross Area | Cavity Insulation R-Value | Continuous Insulation R-Value | U-factor | SHGC |
|-----------|---|---------------------|---------------------------|-------------------------------|----------|------|
| 1 Wall | Solid Concrete or Masonry w/ Exterior Insul | 167 ft ² | 9.3 | 1.8 | 0.093 | |
| 2 Window | Metal, Thermal Break, 2 Pane w/ Low-E | 13 ft ² | | | 0.35 | 0.32 |
| 3 Window | Metal, Thermal Break, 2 Pane w/ Low-E | 13 ft ² | | | 0.35 | 0.32 |

Update Window

Metal Frame Double Pane w/ Low-E

Metal Frame w/ Thermal Break Double Pane w/ Low-E

Wood Frame Double Pane w/ Low-E

Vinyl Frame Double Pane w/ Low-E

Other

[» Update Window](#) or [Cancel](#)

Double panel, low E windows are designed to reduce heat loss. These type of glasses are best suited for buildings located in heating dominated climates.

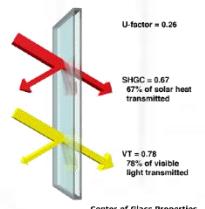


Window Technologies: Glazing Types - Double Low-E Glazing

Double-Glazed, High-solar-gain Low-E Glass

This figure illustrates the characteristics of a typical double glazed window with a high-solar-gain low-E glass with argon gas fill. These windows are designed to reduce heat loss but admit solar gain. High-solar-gain low-E glass products are best suited for buildings located in heating dominated climates and are the product of choice for passive solar design projects.

High-solar-gain low-E glass is often made with pyrolytic low-E coatings, although sputtered high-solar-gain low-E is also available.



Center of Glass Properties

Note: These values are for the center of glass only. They should only be used to compare the effect of different glazing types, not to compare total window products. Frame choice can drastically affect performance. These values are approximate double glazing with a 1/2" air gap.

Whole Window Properties - Double-Glazed, High-solar-gain Low-E Glass

| Frame | Metal Frame | Metal Frame with Thermal Break | Non-metal Frame | Non-metal Frame, Thermally Improved |
|----------|-------------|--------------------------------|-----------------|-------------------------------------|
| U-factor | 0.164-0.70 | 0.41-0.75 | 0.41-0.95 | 0.27-0.31 |
| SHGC | >0.80 | 0.35-0.40 | 0.31-0.40 | 0.21-0.25 |
| VT | >0.80 | 0.35-0.40 | 0.31-0.40 | 0.21-0.25 |

Note: The thermal performance properties of specific glazings and frames can vary depending on product design and make up. The results presented here are averages. Consult specific manufacturers for NFRC rated U-factors and SHGCs for products of interest.



Generated by REScheck-Web Software

Compliance Certificate

Project Duna

Energy Code: **2009 IECC**
 Location: **Dallas, Texas**
 Construction Type: **Single-family**
 Project Type: **New Construction**
 Conditioned Floor Area: **6,500 ft²**
 Glazing Area: **12%**
 Climate Zone: **3 (2259 HDD)**
 Permit Date:
 Permit Number:

Construction Site:

Owner/Agent:

Designer/Contractor:

| Assembly | Gross Area or Perimeter | Cavity R-Value | Cont. R-Value | U-Factor | UA |
|---|-------------------------|----------------|---------------|----------|-----|
| Wall: Solid Concrete or Masonry w/ Exterior Insul | 202 | 3.4 | 1.8 | 0.164 | 33 |
| Wall: Other | 486 | | | 0.230 | 112 |
| Wall: Other | 547 | | | 0.230 | 126 |
| Wall: Solid Concrete or Masonry w/ Exterior Insul | 1,035 | 9.3 | 1.8 | 0.093 | 96 |
| Wall: Solid Concrete or Masonry w/ Exterior Insul | 103 | 9.3 | 1.8 | 0.093 | 10 |
| Wall: Other | 380 | | | 0.230 | 87 |
| Wall: Solid Concrete or Masonry w/ Exterior Insul | 555 | 3.4 | 1.8 | 0.164 | 91 |
| Wall: Other | 1,453 | | | 0.230 | 334 |
| Wall: Solid Concrete or Masonry w/ Exterior Insul | 483 | 9.3 | 1.8 | 0.093 | 45 |

Compliance Statement: The proposed building design described here is consistent with the building plans, specifications, and other calculations submitted with the permit application. The proposed building has been designed to meet the 2009 IECC requirements in REScheck Version 5.5.0 and to comply with the mandatory requirements listed in the REScheck Inspection Checklist.

Name - Title

Signature

Date

Compliance: Passes using UA trade-off

Compliance: **5.1% Better Than Code** Maximum UA: **1634** Your UA: **1551** Maximum SHGC: **0.30** Your SHGC: **0.30**
 The % Better Than Code Index reflects how close to compliance the house is based on code trade-off rules.
 It DOES NOT provide an estimate of energy use or cost relative to a minimum-code home.

Envelope Assemblies

| Assembly | Gross Area or Perimeter | Cavity R-Value | Cont. R-Value | U-Factor | UA |
|---|-------------------------|----------------|---------------|----------|-----|
| Wall: Solid Concrete or Masonry w/ Exterior Insul | 1,712 | 9.3 | 1.8 | 0.093 | 139 |
| Window: Wood Frame, 2 Pane w/ Low-E SHGC: 0.30 | 16 | | | 0.230 | 4 |
| Window: Wood Frame, 2 Pane w/ Low-E SHGC: 0.30 | 16 | | | 0.230 | 4 |
| Window: Wood Frame, 2 Pane w/ Low-E SHGC: 0.30 | 18 | | | 0.230 | 4 |
| Door: Glass SHGC: 0.30 | 171 | | | 0.230 | 39 |
| Wall: Solid Concrete or Masonry w/ Exterior Insul | 539 | 9.3 | 1.8 | 0.093 | 26 |
| Window: Wood Frame, 2 Pane w/ Low-E SHGC: 0.30 | 264 | | | 0.230 | 61 |
| Wall: Solid Concrete or Masonry w/ Exterior Insul | 196 | 9.3 | 1.8 | 0.093 | 18 |
| Wall: Solid Concrete or Masonry w/ Exterior Insul | 237 | 9.3 | 1.8 | 0.093 | 12 |
| Door: Solid | 109 | | | 0.080 | 9 |
| Wall: Solid Concrete or Masonry w/ Exterior Insul | 440 | 12.7 | 1.8 | 0.072 | 32 |
| Wall: Solid Concrete or Masonry w/ Exterior Insul | 295 | 9.3 | 1.8 | 0.093 | 27 |
| Wall: Solid Concrete or Masonry w/ No Insul | 600 | | | 0.333 | 88 |
| Window: Wood Frame, Single Pane SHGC: 0.30 | 335 | | | 0.230 | 77 |
| Wall: Solid Concrete or Masonry w/ Exterior Insul | 383 | 9.3 | 1.8 | 0.093 | 8 |
| | 300 | | | 0.230 | 69 |

Project Title: Duna
 Data filename:

Report date: 11/16/15
 Page 1 of 8

Project Title: Duna
 Data filename:

Report date: 11/16/15
 Page 2 of 8

- Appendix A: Recommended strategies through the integrative process of the building

| | | |
|----------------------|--------------------------------|--|
| Site & Ecosystems | Site Selection | Avoid building on a flood-prone property Avoid building in flood-prone areas |
| | Land Development | Limit parking area Cluster buildings to preserve open space and protect habitat |
| | Landscaping | Convert turf areas to native desert, prairie, or woodland ecosystem |
| Energy use | Building Envelope | Minimize wall area through proper building massing Keep all mechanical, electrical and plumbing systems within the air & vapor barriers |
| | Heating, cooling & ventilation | Reduce internal heat gain by improving lighting and appliance efficiency Use Evaporative cooling |
| | | Do not shade the south side of the building with trees Use low partitions near the exterior glazing to promote daylight penetration |
| | | Use light levels appropriate for different tasks use different tasks and ambient lighting |
| | Lighting | Minimize outdoor lighting |
| Water use | Landscaping | Use mulch to improve water retention |
| | Plumbing & Fixtures | Avoid or remove garbage disposers Design floorplan to minimize length of hot water piping Size water supply pipes appropriately, assuming use of water-efficient fixtures |
| | | Install point-of-use hot water heaters |
| | | Check for rebates on water-conserving fixtures and landscaping |
| | General | Check for rebates on water-conserving appliances |
| Resource & Materials | Resource Efficiency | Reconsider whether all space demands in building program are needed Determine whether varying functions can be accommodated in shared spaces Group or stack bathrooms and other water-using spaces Minimize spaces devoted exclusively to circulation design and build components with constituent parts of equivalent longevity Prefer materials that are sourced and manufactured within the local area |
| | | Assess whether the building is truly needed |
| | | Identify items to be salvaged from existing structure |
| | | Identify items to be reused from existing structure |
| | | Recycle materials to be discarded from existing structure |
| | | Avoid composite materials to facilitate recycling |
| | C&D Waste Management | Avoid conventional preservative-treated wood Specify aluminum products made from high levels of recycled scrap Use the most efficient section to optimize material use Run Air ducts only to interior of each room, not to building perimeter Use precast structural concrete components Use straw bales to construct non-load-bearing walls |
| | | Use salvage steel members |
| | | Use light-gauge steel for interior partitions |
| | | Place primarily unoccupied space away from daylight sources |
| | | Recommended a non-smoking policy for the building |
| Indoor Environment | Construction & Operation | |

- Appendix B: R-value for different types of materials

| Material | R/Inch | R/Thickness |
|-------------------------------|--------|-------------|
| Construction Materials | | |
| Concrete Block 4" | | 0.8 |
| Concrete Block 8" | | 1.11 |
| Concrete Block 12" | | 1.28 |
| Brick 4" common | | 0.8 |
| Brick 4" face | | 0.44 |
| Poured Concrete | 0.08 | |
| Soft Wood Lumber | 1.25 | |
| 2" nominal (1 1/2") | | 1.88 |
| 2x4 (3 1/2") | | 4.38 |
| 2x6 (5 1/2") | | 6.88 |
| Cedar Logs and Lumber | 1.33 | |
| Sheathing Materials | | |
| Plywood | 1.25 | |
| 1/4" | | 0.31 |
| 3/8" | | 0.47 |
| 1/2" | | 0.63 |
| 5/8" | | 0.77 |
| 3/4" | | 0.94 |
| Fiberboard | 2.64 | |
| 1/2" | | 1.32 |
| 25/32" | | 2.06 |
| Fiberglass (3/4") | | 3 |
| (1") | | 4 |
| (1 1/2") | | 6 |
| Extruded Polystyrene (3/4") | | 3.75 |
| (1") | | 7.2 |
| (1 1/2") | | 10.8 |

| Material | R/Inch | R/Thickness |
|-------------------------------|--------|-------------|
| Flooring Materials | | |
| Plywood | 1.25 | |
| 3/4" | | 0.93 |
| Particle Board (underlayment) | 1.31 | |
| (5/8") | | 0.82 |
| Hardwood Flooring | 0.91 | |
| (3/4") | | 0.68 |
| Tile, Linoleum | | 0.05 |
| Carpet (fibrous pad) | | 2.08 |
| (rubber pad) | | 1.23 |
| Roofing Materials | | |
| Wood Shingles | | 0.97 |
| Asphalt Shingles | | 0.44 |

| Material | R/Inch | R/Thickness |
|--|--------|-------------|
| Siding Materials | | |
| Hardboard (1/2") | | 0.34 |
| Plywood (5/8") | | 0.77 |
| (3/4") | | 0.93 |
| Wood Bevel Lapped | | 0.8 |
| Aluminum, Steel, Vinyl (hollow backed) | | 0.61 |
| (w/ 1/2" Insulating board) | | 1.8 |
| Brick 4" | | 0.44 |
| Interior Finish Materials | | |
| Gypsum Board (drywall 1/2") | | 0.45 |
| (5/8") | | 0.56 |
| Paneling (3/8") | | 0.47 |

- Appendix C: Parking requirement codes by the occupancy

PARKING REQUIREMENTS

TYPE OF OCCUPANCY PARKING SPACES

Class 1. Office

- a. Office
- b. Financial Facility

2.5 spaces for every one thousand square feet of GFA or 2.75 for every one thousand square feet of UFA.
 4.0 spaces for every one thousand square feet of GFA.
 * * * *

Class 2. Residential

- a. Apartment House

1.250 spaces for each efficiency apartment.
 1.333 spaces for each one bedroom apartment.
 1.666 spaces for each two bedroom apartment.
 2.0 spaces for each apartment with three (3) or more bedrooms.
 2.0 parking spaces for each dwelling unit.
 2.0 parking spaces per dwelling unit.
 0.3 parking spaces per sleeping room, plus 1 parking space per employee on largest shift.
 0.75 spaces per dwelling, plus parking spaces for support based upon the provisions of Section 26-28 hereof. (w/kitchen facilities)
 1.0 space for every 6 beds, plus 1.0 space per employee on largest shift. (no kitchens)
 1.0 parking space for each sleeping room up to 250 rooms; 0.75 parking spaces for each sleeping room from 251 rooms to 500 rooms; 0.50 parking spaces for each sleeping room in excess of 500 rooms.
 * * * *

Class 3. Health Care Facilities

- a. Hospital
- b. Psychiatric Hospital
- c. Clinic (Medical Complex)
- d. Clinic (Medical or Dental)
- e. Nursing Home
- f. Funeral Home or Mortuary
- g. Veterinary Clinic

2.2 spaces for each bed proposed to be constructed.
 1.0 space for each four (4) beds proposed to be constructed and 1.0 space for every four employees.
 2.7 spaces for every one thousand square feet of GFA.
 3.5 spaces for every one thousand square feet of GFA.
 1.0 space for every three beds proposed to be constructed and 1.0 space for every four employees.
 0.5 spaces for every chapel.
 5.0 spaces for every one thousand square feet of UFA
 * * * *

Class 4. Industrial, Commercial Manufacturing

- a. Multi-Tenant (no multi-building project)
 - 1. At Grade (no docks)
 - 2. Semi-Dock High
 - 3. Full-Dock High
- b. Bulk Warehouse
- c. Heavy Manufacturing and Industrial
- d. Light Manufacturing, Assembly and Research and Development
- e. Transportation Terminal
- f. Truck Terminal
- g. Mini-Warehouse Facilities

2.5 spaces per one thousand square feet of GFA of office space; and 1.0 space per five thousand square feet of GFA of warehouse space.
 2.5 spaces per one thousand square feet of GFA of office space; and 1.0 space per five thousand square feet of GFA of warehouse space.
 2.5 spaces per one thousand square feet of GFA of office space; and 1.0 space per seven thousand square feet of GFA of warehouse space.
 2.5 spaces per one thousand square feet of GFA of office space; and 1.0 space per seven thousand square feet of GFA of warehouse space.
 2.5 spaces per one thousand square feet of GFA of office space; and 1.0 space per two thousand square feet of GFA of warehouse space.
 2.5 spaces per one thousand square feet of GFA of office space; and 1.0 space per one thousand five hundred

square feet of GFA of assembly space.
 6.5 spaces per one thousand square feet of GFA of waiting area.
 1.0 spaces per two thousand square feet of GFA.
 1.0 space for every 40 storage units or bays.
 * * * *

Class 5. Religious and Educational

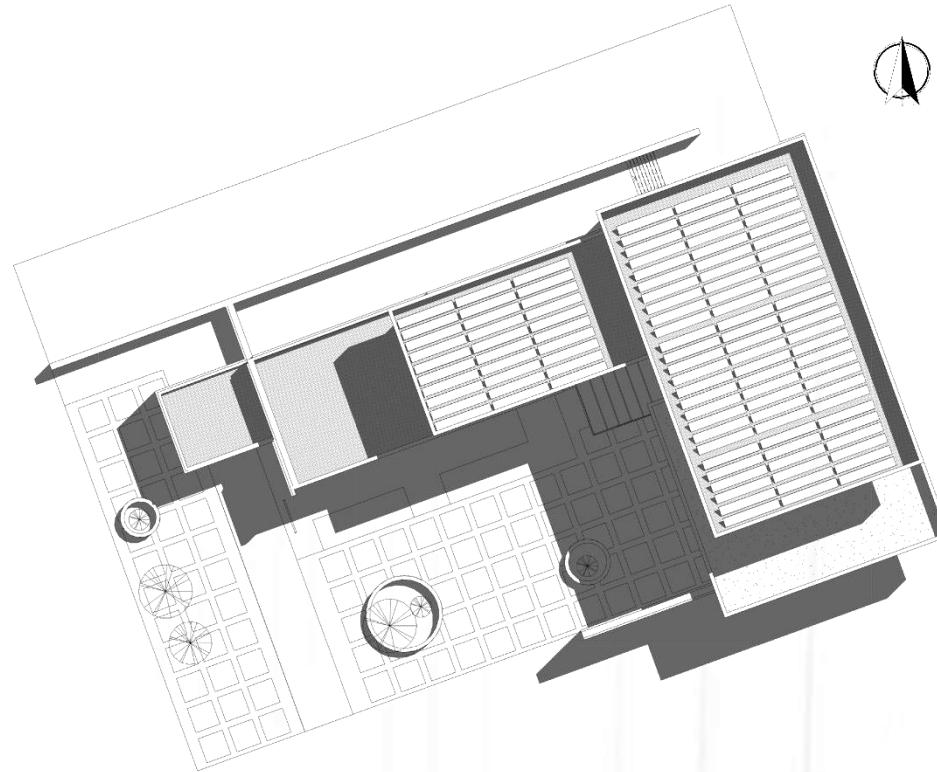
- a. Church
- b. Nursery School or Day Care Center
- c. School (Public, Denominational or Private)
 - 1. Elementary School
 - 2. Junior High School
 - 3. Senior High School
- d. College or University or Trade School
- e. Library
- f. Art Gallery or Museum

1.0 space for every five fixed seats in auditorium or sanctuary or, if there are no fixed seats, 1.0 space for every 40 square feet of GFA in the main auditorium or sanctuary.
 1.0 space for every employee on duty during the largest shift plus 1.0 space for every 5 children in attendance when the facility is operating at maximum capacity or, if drop-off facilities are provided under Section 26-40(1)(d) hereof, 1.0 spaces for every employee on duty during the largest shift and 1.0 space for every 10 children in attendance when the facility is operating at maximum capacity.
 1.5 spaces per 30 person classroom.
 3.5 spaces per 30 person classroom.
 9.5 spaces per 30 person classroom.
 1.0 space for every three employees plus 1.0 space for every 10 students residing on campus and 1.0 space for every 5 students not residing on campus.
 1.2 spaces for every one thousand square feet of GFA.
 3.0 spaces for every one thousand square feet of GFA of exhibit area or gallery space.
 * * * *

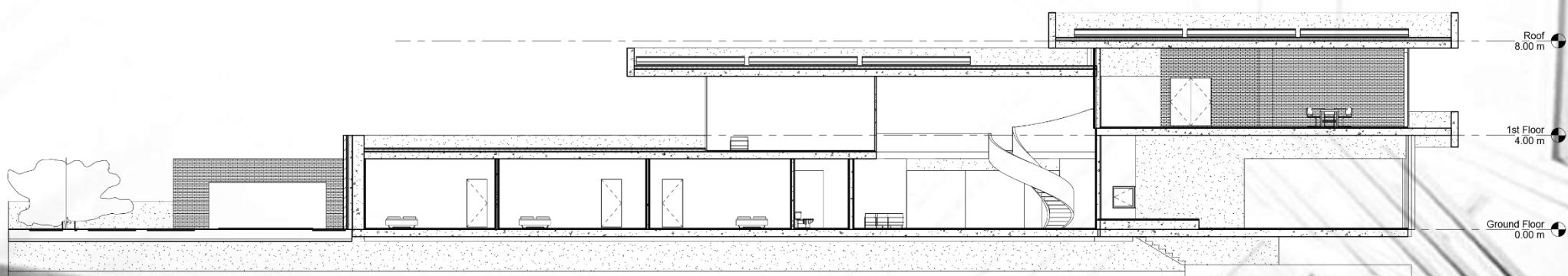
- Appendix D: Points for percentage improvement in energy performance

| New Construction | Major Renovation | Core and Shell | Points (except Schools, Healthcare) | Points Healthcare | Points Schools |
|------------------|------------------|----------------|-------------------------------------|-------------------|----------------|
| 6% | 4% | 3% | 1 | 3 | 1 |
| 8% | 6% | 5% | 2 | 4 | 2 |
| 10% | 8% | 7% | 3 | 5 | 3 |
| 12% | 10% | 9% | 4 | 6 | 4 |
| 14% | 12% | 11% | 5 | 7 | 5 |
| 16% | 14% | 13% | 6 | 8 | 6 |
| 18% | 16% | 15% | 7 | 9 | 7 |
| 20% | 18% | 17% | 8 | 10 | 8 |
| 22% | 20% | 19% | 9 | 11 | 9 |
| 24% | 22% | 21% | 10 | 12 | 10 |
| 26% | 24% | 23% | 11 | 13 | 11 |
| 29% | 27% | 26% | 12 | 14 | 12 |
| 32% | 30% | 29% | 13 | 15 | 13 |
| 35% | 33% | 32% | 14 | 16 | 14 |
| 38% | 36% | 35% | 15 | 17 | 15 |
| 42% | 40% | 39% | 16 | 18 | 16 |
| 46% | 44% | 43% | 17 | 19 | - |
| 50% | 48% | 47% | 18 | 20 | - |

- Appendix E: The residential documents



Site Plan



Section A-A

- Appendix E: The residential documents

