Section II- Orientation and Form

a.) Summary:
Orientation makes a difference in energy use, and must be determined in the early design stages. Along with energy performance, orientation affects the visual quality of the buildings and comfort of the occupants. A proper orientation of the building also reduces the need for artificial heating, cooling, and lighting.

- Orient buildings on the east-west axis (+/-10°).
- Reduce west facing glass
- Shade south glazing
- Take advantage of, or block, prevailing winds

b.) Technical Information:
While orientation is important to consider for peak loads and comfort, the energy impacts of orientation can be minor and dwarfed other systems such as lighting or ventilation. The case study below shows that the different orientations of a new school only had a $700 or 1% impact on the total energy use. Orientation can also be at odds with form when it comes to comparing a long narrow building that takes advantage of a south facing orientation versus a more square form that has the same area, but less perimeter to loose heat. Sometimes simple modeling scenarios can help guide the designer to weigh and balance specific tradeoffs.

Recommendations for orientation vary based on location, depending on the angle of the sun. The heat received from the sun will be different for each side of the building. In the Northern Hemisphere (e.g. Illinois), it is best to orient the building on the east-west axis (+/-10°) with south facing windows and overhangs. This allows the building to take advantage of solar gains during the winter and avoid solar heat during the summer.

Building shading, such as light shelves or overhangs, on south glazing can be designed to provide shade during the summer and allow for heating during the winter, thereby reducing heating and cooling costs. The south face requires horizontal shading, whereas the east and west benefit from both horizontal and vertical shadings. This orientation enables daylight to most of the building spaces and can reduce the need for artificial lighting.

Depending on the climate, the glazing area on the west can possibly be minimized, and setting up enclosure of high thermal mass may be beneficial. The thermal mass absorbs and stores solar energy and releases to the interior at
night. This strategy avoids visual discomfort to the occupants caused by low sun angles during sunset.

The building should also be oriented to maximize cool breezes during the summer and avoid cold winds during the winter. Aligning the longer side of the building perpendicular to the wind direction can maximize natural ventilation and reduce or eliminate the need for artificial cooling and ventilation. This strategy should also consider outside opportunities for shading, such as trees, mounds, hills, neighboring buildings, etc.

c. Case Study: Science and Technology Magnet School in Champaign, IL

The Science and Technology School in Champaign, IL is a new construction building that has been occupied for about two years. It has large overhangs on the south side. Most of the windows are located on the north and south sides, with fewer on the east and west.

Modeling of this building illustrates a variation of around $700 in energy due to its orientation. However, this is only about 1% of the total yearly energy cost.

East-west axis (See savings below):
d.) Potential Issues:
This Midwestern building has a large curtain wall that faces west. As the sun is setting, the west elevation is heated throughout the afternoon. This orientation issue can pose challenges for the HVAC system and comfort for occupants.