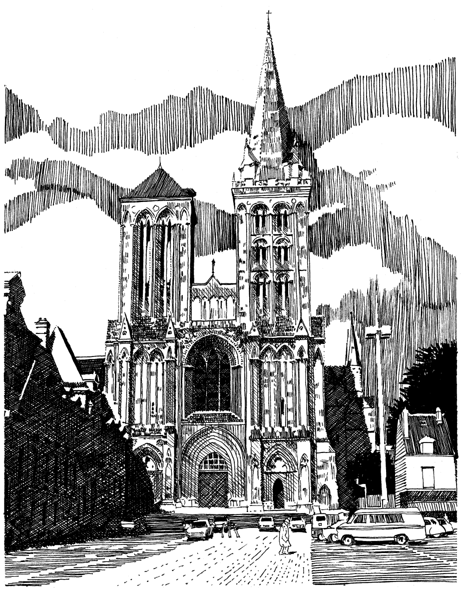
ARCHITECTURE

EHLINGER & ASSOCIATES **FOURTH QUARTER 2000**

SEASONS GREETINGS

The staff of Ehlinger & Associates extends Seasons Greetings to all of our friends who receive the newsletter. Merry Christmas, Happy Hanukkah, and Happy New Year.



ST. PIERRE CATHEDRAL

Lisieaux, France

Lisieaux is the primary commercial and industrial town in the Auge region of the Normandy Department in France. It is situated on the Touques River about 40 kilometers (24 miles) due south of Le-Havre, the main port of France on the English Channel. The old section of Lisieaux was totally destroyed in World War II except for St. Pierre Cathedral. Lisieaux has fully recovered from the war today and is a typical example of a small town in Normandy.

The town is famous today as a pilgrimage center for devotion to St. Teresa of Lisieaux (St. Thèrése Martin). She was born in 1873, became a Carmelite nun at age 15, and died at an early age. ***History of a Soul*** is the story of her life that she authored. It was finished only days before she entered the hospital to die a slow and agonizing death. She was beatified in 1923 and canonized in 1925 as a Saint.

The Cathedral is on the square in the center of what was the old town. It was begun in 1170 and not completed until the middle of the 13th Century. The primary style is Gothic although the tower on the right of the west facade was rebuilt in the 16th Century (the Renaissance Period!) in the Romanesque Style (the 11th Century) and given a spire in the 17th Century. It thus is similar to the famous Cathedral at Chartres in having an asymmetrical facade. The south facade / entrance was rebuilt in the 15th Century and contains the famous "Paradise Door" as its entrance, has a gallery that surmounts it, and is flanked by massive buttresses.

At the crossing there is the typical lantern / spire of Norman churches that crowns the transept. The nave begins on robust round columns with circular capitals supporting wide arches, again typical in Norman churches (even when in England after the conquest, as in Durham Cathedral), continues up through the blind triforium gallery to the grand clerestory windows and groin vaulting. The Chancel from the 13th Century circles round the east to the large central Chapel built in the Flamboyant Gothic Style in the 15th Century. This was done by Pierre Cauchon, Bishop of Lisieaux, after the trial of Joan of Arc that he presided over in nearby Rouen.

Welcome Aboard!

Louis Price joined E&A on the 1st of November to head our marketing efforts in Alabama. Louis brings a wealth of experience to the job having completed two four year terms as Mayor of Scottsboro, Alabama after retirement from a career as General Manager of the Scottsboro Power Company for 38 years.

Louis was born in Cullman, Alabama and lived there on a farm until completion of high school. He then served in the army for 33 months, 13 of which were in the combat zone of Korea. After Korea, he moved to Scottsboro and took a position with the Scottsboro Electric Power Board, the city owned utility, as accountant. He furthered his education at night by taking classes in accounting and business administration at a nearby business college, and gradually worked his way up to General Manager.

Louis has been married for 51 years to Mildred (Maggie) Blair. They have 3 children - Nita, Lynn and David. Nita is married to Robbie Farquhar; they live in Huntsville and have 3 sons. Nita works in public relations and marketing at the Space & Rocket Center. Lynn is now the wife of John Morgan with 2 daughters and

3 step-grandaughters making Maggie and Louis great grandparents to the three. Lynn works for the Tennessee Valley Authority in Data Processing. David lives in West Palm Beach, FL where he is the Superintendent of the golf course at the Breakers West Golf Complex. David has 1 daughter and his wife has a son and 1 daughter.

Louis and Maggie enjoy travelling in their motor home and playing golf together. Louis enjoys fishing, hunting and spectator sports. They are both active in their church where Maggie sings in the choir.

GONE WITH THE WIND...

Hurricane Andrew which hit Florida and Louisiana in 1992, and Hurricane Iniki which hit Hawaii also in 1992, caused a re-evaluation of both the design and construction of buildings for wind resistance. Certain design weakness became evident in failed buildings, such as not designing the window and door components to fully resist the wind. When the glass blows out or is knocked out by flying missiles, the building behaves differently in the wind -- like an open building with consequently much higher wind pressures on building surfaces. This caused many buildings to progressively fail to collapse. Construction practices such as use of staples to fasten roof decking to rafters or trusses also caused progressive failures when one sheet of plywood would lift at the edge, blow off, and then cause the next one to do so also, and so on.

Research has indicated for years that wind pressures affect various building shapes in specific ways, and that the pressures vary per the local topography. When the wind is coming over an open landscape like the water, the velocities and consequent pressures are higher than if coming over smooth terrain, rough terrain or the center of a large city. Also, the velocity of the wind is zero at the ground level and increases in velocity with height, the ground itself slowing down the wind by friction. This is called the "boundary layer effect", where the ground produces drag and slows the wind. Consequently, velocity measurements are always made or calculated (if measured at a different height) to the same height above the ground: 33 feet, to build a data base of wind speeds that are comparable.

The pressure produced by wind is derived from Bernoulli's Theorem and is given as $q=0.00256v^2$, where q = velocity pressure, and v = the velocity, and these values are derived from density of air and correlation of mass and velocity.

The height above the ground affects the velocity because of the boundary layer effect previously mentioned, and this is accounted for by the power law, which is an exponential mathematical model that describes this varying velocity. The general form of the power law is:

$\frac{Vz}{Vx} = \left(\frac{z}{X}\right)^{\frac{1}{\alpha}}$ where Vz is the wind velocity at a height z above the ground and Vx is the wind velocity at height x above the ground surface. The exponent α describes the terrain roughness. The equation can be restated as:

$$Vx = V_{33}\left(\frac{X}{33}\right)^{\frac{1}{\alpha}}$$

for a height of 33 feet above the ground with x being the height sought after. The $\frac{1}{\alpha}$ exponent varies from 1/10.5 for coastal waters to 1/2 for the center of a large city. It can thus be seen that the pressure varies greatly with the terrain and the height above the ground. As one goes higher the pressure is increasing with the square of the velocity increase. This is why taller buildings are more difficult to design for and why hurricanes and tornadoes are more difficult to design for. Wind speeds over 140 MPH become very expensive to defend against because of the pressure increasing with the square of the velocity.

Because of Bernoulli's Theorem also, the shape of the building affects the pressure of the wind on its surfaces. In general, the pressures are always higher at the corners and edges. The juncture of roof to wall, and roof plane to roof plane are where the pressures are greatest, and where the failures of components and cladding of the structure first begin. Flat roofs have an uplift, whereas pitched roofs may have uplift or downward pressure depending upon the angle of the pitch. The windward side of the building thus has a positive, inward pressure that increases in intensity toward the top of the building, while the leeward side has a negative pressure, pulling away from the building (this is usually expressed as a constant value for the entire height, unlike the varying pressure on the windward side. The side walls also have a constant negative or outward pressure. The convention in design is to derive a design pressure from the velocity pressure that is a fraction of the velocity pressure times a gust factor, based upon empirical testing of various shapes. The design pressure on the total building windward plus leeward is usually around .6 to 1.2 times the velocity pressure, with the higher pressure coefficients being on the corners. Even higher coefficients are used to create greater design pressures for the smaller areas of components and cladding of the building. This affords stronger connections as well as the component and cladding, and is not applied to the building frames or the total building.

New types of glass have been developed where the glass may break in bending due to wind pressure or by impact due to flying missiles, but the plastic laminate keeps it together and intact within the frame. This way the building functions as a closed shape rather than an open one, and hopefully survives intact. Similarly, because of the higher pressure required on components and cladding, they will not peel off the frame and create a progressive failure. Even so, the frame design is also stronger now because of the greater pressures that the frames are now required to withstand.

PRESSURE DISTRIBUTION AT SIMPLE STRUCTURE