



# ARCHITECTURE

EHLINGER & ASSOCIATES

FOURTH QUARTER 1995



## 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.



**WESTMINSTER ABBEY**  
London, England, United Kingdom

In Westminster Abbey, this issue's limited edition signed print by Ladd P. Ehlinger, William the Conqueror was crowned King of England on Christmas Day 1066. All the kings and queens of England since then have had their coronation ceremonies in this ancient church.

The original construction of the Abbey preceded William the Conqueror by approximately 400 years. A church on this site was started by Sebert, a 6th century East Saxon King. Edward the Confessor rebuilt the church in the Norman style with the intention of making it his sepulcher. He died and was buried in it within a week of its completion in 1065.

As to the origin of the name, there is a curious old English inscription in the choir of the present church that begins with: "*Westmonasterie Abbey*.." — all one word. It is the writer's opinion that this may well have been corrupted through time to "*Westminster*". The Abbey is also on the west side of London.

Subsequent monarchs left their mark on the Abbey: Henry III began to rebuild the church in 1220 after being inspired by the Gothic churches at Amiens and Reims. Henry VII constructed his chapel on the east end in 1503-19 in the Perpendicular Gothic style, with beautiful fan vaulting. It was the jewel of its age and perhaps the entire complex.

The upper parts of the west towers, shown in the sketch, were not completed until 1722-45 (well after the Gothic age), but were designed sympathetically by Sir Christopher Wren and the architect Hawksmoor. Even major repairs by Sir Gilbert Scott have respected the Gothic style of the entire ensemble.

It was Henry VIII who ordered the dissolution of all of the monasteries in 1540 and confiscated all of their property. None of the Abbey churches were destroyed, unlike what the French did during their revolution. Elizabeth I re-established Westminster as a church and College to replace the monastic school.

Besides the usual famous and important politicians, statesmen and personages of royalty, Westminster Abbey also has buried and memorials to musicians in a musicians aisle, and poets in the poets corner of the north transept.

One of the poets buried there is Chaucer, who was incidentally the Clerk of the Works during one of the constructions of the Abbey. Statues only of Dryden, John Milton, William Blake, Ben Jonson, Robert Burns, Longfellow and others caused Joseph Addison to remark in the 18th century that "...in the poetical corner I found there were poets who had no monuments and monuments which had no poets".

The granite column in the foreground to the left of the Abbey in the sketch is a monument in memory of former pupils of the Westminster School who died in the Indian Mutiny and the Crimean War. The tower immediately to the left of the Abbey in the background is the bell tower of Saint Margaret's Church, the church of the House of Commons of Parliament. To the left of it, further in the background is Big Ben, the clock tower of the Parliament buildings ensemble.

Statistically, the Abbey is 511'-6" long in the EW direction; length of nave 166'; width of nave including aisles 72'; height of nave 102'; height of the west towers to the pinnacles 225'.

## LEANING TOWERS

The most famous leaning tower is probably that of Pisa, but there are many other leaning towers in other architectural complexes and locations. These towers are usually associated with churches as the campanile or bell tower, although some, particularly in Italy, were built privately for defensive purposes.

Two towers in Bologna, also built in the twelfth century as was Pisa, lean noticeable. They are both square in plan, built of brick, and are plain in appearance. The *Torre Asinelli* (1109) is 323' high and 4' out of plumb. The *Torre Garisenda* is 157' high and 10' out of plumb. Some believe that this tower was once much higher.



Pisa was started about 60 years after the Bologna towers, and is now more than 13' out of plumb. Some believe, that at Pisa and at several other towers, the construction was intentionally built to be out of plumb. They reached this conclusion after studying the details of the towers, such as the inclination of window sills on the high and low sides wherein the slope appears to be correct even though the tower is now leaning. Others explain this as being a response to the settlement that was taking place during the construction.

The writer is of the opinion that the towers settled differentially due to the

ignorance of their designers of soil mechanics and static equilibrium theories. The anomalies of their construction were probably the result of responding to settlement that was severe during the construction, probably before the towers were half finished. Soil mechanics as an engineering discipline did not exist at the time these towers were designed, and didn't come into its own until the 1920's and 1930's. Statics became a complete engineering discipline in the mid nineteenth century.

Pisa has continued to move and lean further outward over the centuries, so much so that numerous soils and structural experts have predicted that it will collapse soon if the movement is not arrested. Work has been proceeding to do just that, with the tower being closed to the public while this is taking place.

The engineers in charge have announced that the movement has in fact been reversed — the tower has moved more toward the vertical a significant amount. The lower section of the tower around the inner cylinder was encased with multiple steel straps similar to barrel hoops, to prevent the stone from crumbling or exploding on the low side where the pressure is greatest. Lead weights were hung on the high side off these same hoops to counteract the direction of movement. So far, it appears to be working.

In Pisa, there are two other leaning towers: S. Michele dei Scalzi and S. Niccolò. The latter was designed by Niccolò Pisano. The campanile at St. Mark's in Venice leans slightly. S. Giorgio dei Greci, S. Stefano and S. Geremia, also all in Venice, lean considerably. Elsewhere in Italy, there are leaning towers at Burano, Padua, Este, Rovigo, Ferrara, and Modena.

The cathedral at Cologne, the cathedral of Salisbury and Caerphilly in Wales lean a large amount. The tower over the crossing at Salisbury has in fact failed the foundations of the entire crossing so much (over 1.5' of differential settlement) that all of the arches and

groin vaults in this area are severely distorted.



## SALISBURY Cathedral and Cathedral Close

Today, with our knowledge of soil mechanics and expertise in foundation design, the likelihood of leaning towers is very low — as is the client's willingness to accept them.

### THE TOWER OF LONDON

While we are on the subject of towers, and while we speak the same language as the English, it is interesting to note that the Tower of London really isn't a tower at all!

The main building is rather tall, but certainly not what we Americans would consider a tower. The Tower of London is the name of the fortifications built by William the Conqueror shortly after the Battle of Hastings in 1066.