The Iron Pillar of Delhi

I started my metallurgy degree course at Lanchester Polytechnic (Now Coventry University) in 1966.

One of the first lectures we attended was called Generally Metallurgy and was about the basics of metals. We were told that the most important metal was iron which was used in alloys such as Wrought Iron, Cast Iron and Steel. This was because it is in plentiful supply, reasonably cheap, very strong and could be treated to be in a variety of conditions.

Its biggest problem was thought to be corrosion but this was not always the case and old example which showed little corrosion and great durability was quoted.

I was expecting him to quote the Ironbridge in Shropshire but no he referred to the Iron Pillar of Delhi. This was a big disappointment to me as I was hoping for a student trip to see the Ironbridge after all the Industrial Revolution started in England! A trip to India in 1966 was out of the question

In March 2013 myself and the Wife were able to go to India on a tour of the Golden Triangle. This was Delhi, Jaipur, Agra and villages inbetween. I was delighted that we were visiting Qutub Minar which was also home to the Iron Pillar.

Delhi

This city is located in the North of India on the banks of the Yamuna River. It has a population of 22 million which is rising by ½ million each year. 52% live in slums 82% are Hindu's 12 % Muslims and 4% Sikhs. The area of New Delhi is the capital of India transferred from Calcutta in 1947. New Delhi was built by the British in 1920 during the British Raj (Raj translates to Rule!)

Government Buildings in New Delhi

Delhi Street Scene

Top of a Cupola Furnace Stack in Delhi

Qutub Minar

This was originally an Islamic Mosque and is the oldest landmark in Delhi. Built by the Muslim rulers in 12 century who destroyed the Hindu Temples

The Minaret is 238 feet tall and of red sand stone. It is the most visited item on the site and was open to the public to climb but closed recently due to the number of suicides. It is next to the Iron Pillar

Delhi Iron Pillar

The Pillar is 1600 years old (400-450 AD) and was originally from Candra in Central India.

It's dated from its oldest Sanskrit inscription and was made during the reign of the Imperial Guptas.

Up until recently it was known as a fertility symbol and infertile men stood with their back to it and clasped their hands behind the pillar. This is now banned as the base of the pillar was getting worn away. A fence has been erected around the base.

Its image is used as the Logo of the Indian Metallurgical Institute

Pillar has been used for target practice by the Army in the past

Up until recently the pillar has posed two mysteries. Why is it so corrosion resistant and how was it made?

The Indian Metallurgical Institute did an investigation to answer these questions.

Corrosion Resistance

Parts of the pillar were scraped off and chemical analysis of the Iron was done. This revealed that the Iron contained large amounts of Phosphorous. Normally Iron smelting and refining uses Limestone as a flux which removes most of the Phosphorous and it runs off into the slag. (The Phosphorous weakens the structure of iron and steel) This is not a problem to this pillar as it a decorative item only.

Over the years this Phosphorous has formed a protective layer of Hydrogen Phosphate Hydride on the surface. Some modern day metal finishing processes use a coating of Phosphates as corrosion protection (Phosphating)

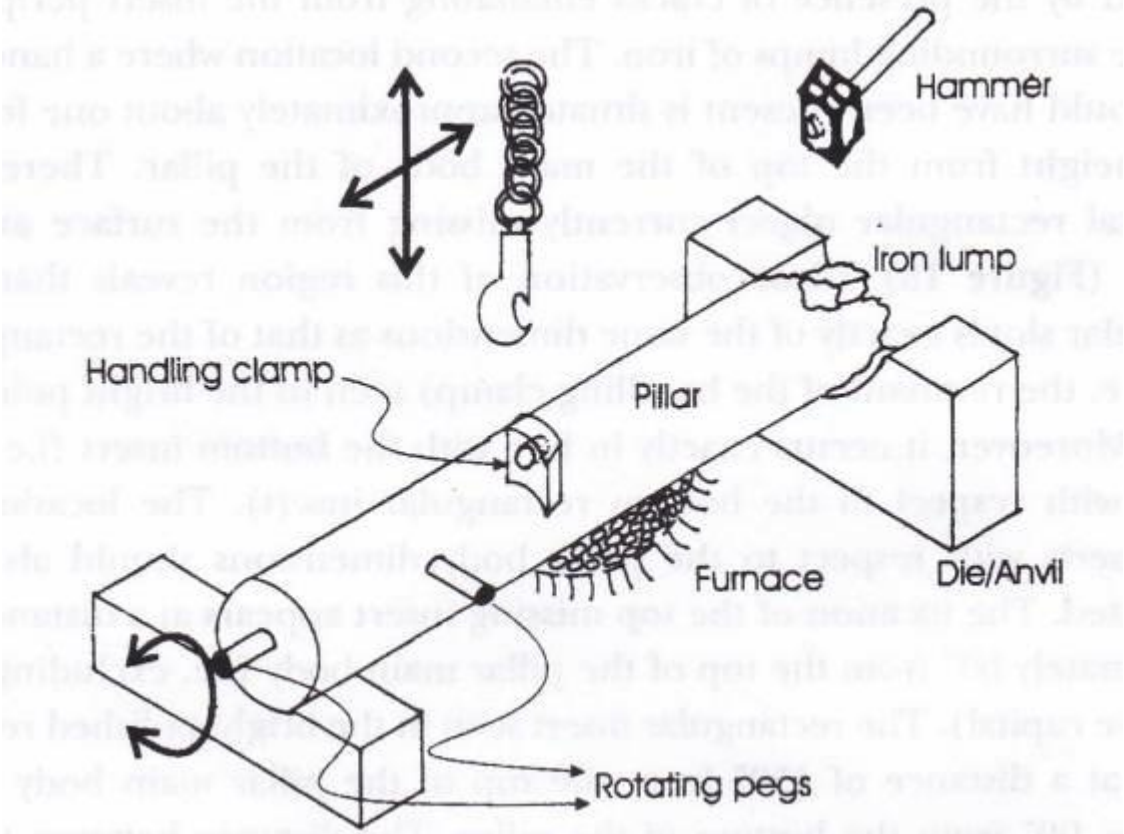
The iron has quite a low carbon content (Variable but around 0, 25%) so it could be classed as Wrought Iron

Manufacture

For the manufacture of the pillar we have to look at the ancient method of iron smelting. This would have been a quite large scale operation with a large area of land set up with many small blast furnaces. These furnaces could would been around 6' high. Made of clay and totally expendable. They would have been charged with Iron Ore and Charcoal. By the use of hand operated bellows, temperatures of around 1100oC could be achieved after a considerable time. Iron melts at 1550oC and cast iron melts at 1200oC so no molten metal would have been produced. The Iron ore would have been chemically reduced by the hot furnace gasses to metallic iron. Blooms of this spongee porous iron would have been formed inside the furnace probably only weighing a few pounds. The furnace would have then been smashed down. The hot blooms extracted and then taken over to the centre of the site where the pillar was been formed. They would have been hammer forged on to the end of the pillar. The pillar would have been over a great fire to aid the hot forging.

Suggested form of Smelting Furnace

Resulting Bloom of wrought iron



The manufacturing process would have involved many men, fires, and time. With the availability of large quantities of steel in these modern day times it is too easy to regard this pillar as just another iron item from the past.

The Iron Pillar of Delhi is a tribute to the men who showed such great ancient metallurgical skills.

Stuart Robertson May 2020