Building Materials IV

Lecture 1

Interesting Applications

So we will look at interesting applications. This is the picture of the construction period of the US capital white house this actually curves. The main Dome is actually two parts.

- Inner Dome
- Outer Dome

The inner dome is actually made of a stone while the outer dome is made of iron. So this is very important application, and shows how iron is important material in building construction industry.

The United State Capitol Dome:

The united state capitol dome is the dome situated above the United State Capitol which reaches upwards to 288 feet (88m) in height and 96 feet (29m) in diameter.

The dome was designed by Thomas U. Walter, the fourth Architect of the capitol, and constructed between 1855 and 1866.

So the dome is not the stone, but cast iron carefully painted to appear to be made of the same stone as the main capital building. It is actually two domes, one is inside and the other is outside. So how is the very prolific used iron.

The Iron Bridge:

And other very important and very historical used iron the iron bridge. It's made completely iron so what is new about the bridge is that it is the first bridge is search it is the arch bridge is made of iron.

- The iron bride is a bridge that crosses the River Severn in Shropshire, England.
- Opened in 1781, it was the first arch bridge in the world to be made of cast iron, and was greatly celebrated after constructed owing to its use of new material. So iron was an upcoming material and its using in construction for the architecture was the very new so this bridge when it was made completely and it was seen that was stand and take that much of bridge. It was very much celebrated.
- The iron bridge was the first of its kind to be constructed, although not the first to be considered or the first iron bridge of any kind. A half-size replica of the main section of the bridge was built in 2001 as part of the research for the BBC to understand how was the bridge was made and to understand it important.

Antoni Gaudi and Iron:

We have very many architects who strict particular use of materials which other styli. And one of the important architecture for the Antoni Gaudi it was very interrogate design which in architect very interrogate pieces of work as for as loose case structures of concern as well as small indicate details Gaudies are concern. So this is particular gate designed by the great architect Antoni Gaudi and can

see the extern to interface to see that's quant's to making and the material that was use to make it was cost irons. So we see how cost iron was an important materials use then give by the architects.

- Iron work has been a Catalan trade since time immemorial, and Gaudi had no trouble incorporating it as a structural and decorative element in his work.
- He was able to count on the very receptive attitude of his fellow artisans, who willingly accepted Gaudi's proposal to revive old techniques and styles. So it being interrogate not very easily accepted by the personal to make it. But the Gaudi was lucky to make it and so the result was so very interrogate and beautiful.
- One of Gaudi's most impressive wrought iron works is the gate of the Guell Pavilions iron Barcelona, constructed in 1885 at the valet I Piquer workshops.

Iron ore: Types of iron:

- There are various types of iron that are obtained from the iron ore. The most important types are as follows,
- Pig iron – pig iron is a basic raw material for all irons.
- Wrought iron – wrought iron is a mechanical mixture of pure iron and silicate slag.
- Malleable iron – malleable cast iron is obtained from hard and brittle white iron, though a controlled heat treatment conversion process.

Iron ore: processing:

So we will take briefly about iron on manufacture. So what happens is iron ore mine iron is not directly present in the form of basic element it's present in the form of ore or mixed to other materials like that of silicate or it slake.

So it's basically mind and then its crushed so how it minds is exploded into small bolder its an crushed and made an to smaller forms then its concentrated into further small forms so that been used to further find crushing. It is next taken to the stage of mixing were it is mixed as water and further separated. So the process basically involves separating iron from the ore, finally after its most its concentrated form is pelletized into small pellets.

Pig iron History:

Which is shift from there on various types of iron which will be looking at so the first iron that will be looking at pig iron.

Pig iron is one that fascinates the non-English speaker. According to tradition at the international pig iron secretariat the name comes from the combination of using agricultural labourers in the first iron plants that then "saw" pigs suckling in the shapes of the launder, so what happen as iron was melted and it was formed when it is formed it is suppose to be formed in terms of little parts that fortunate from a main branch. So parentally the labourers who is actually first solid felt that these for actually looking like the piglets which is feeding from mother pig these is right called pig iron it is a very peculiar but the name suck and pig iron is a very important for iron which is used industries for various uses.

Smelting and producing pig iron and other iron products was known to the Ancient Egyptians and gradually spread around the Eastern Mediterranean as far as Ancient Greece. So as with the case of most materials as the most technology the engine bridge. very adopt in using iron and the smelting of iron are basically extracting iron from its work and it was very famous for very known to the gepsence and its also set were spread also as Greece. So I told you about how pig iron got in same.

This is wave first for most pig iron is made you can see that there are parts. So what happen is the pig iron flows basically into various forms giving a small piglet kind of feeling which wrights name in pig iron.

Pig iron: properties and uses

So we will talk about various properties and the various uses as applications.

Physical properties:

- It is weak and brittle
- It can be welded or riveted
- It is difficult to bend
- It has a low melting point. So these all make a characteristic set a features make it uses usable and non usable as requirements of concern.

Uses:

- For production of casting iron. So iron is basically used to produce steel is the most important function of iron. So apart from that is also being made other types of iron. So as were the pig iron is concern is main purpose is to make of cost iron.
- As raw material for production of wrought iron and steel.
- Pig iron can also be used to produce gray iron which is suitable for producing ductile iron. So again and again it's produced in order to make other forms of iron. So what happens is pig iron is self is not a sound material so it has to be enhanced or it has to be made into some other point in order to be used.

Types of pig iron:

- Basic pig iron – it is used for steel making. Due to low silicon percentage it prevents the attack of refractory lining of refining furnaces and to control slag formation. So being able to consider slag formation results in very low silicon percentage thus its make to use steel.
- Foundry pig iron – it is used for the production of iron castings. So we talk about cast iron and will be talk about cast iron applications. So foundry pig iron is used directly in casting.
- Ferroalloys – these are alloys of pig iron, each rich in one specific element. Ferroalloys are used as additives in iron and steel industries to control or change the properties of iron and steel. So basically pig iron in itself cannot it exist as the material for it is basically used control or enhance the other products or properties of iron and steel. So the types of iron are the grey pig iron, mottled pig iron, and white pig iron.

Cast Iron and Wrought Iron

So we will now move in to pig iron from pig iron to cast iron. Cost iron is the most important material as for iron is concern in the history of building making. Cost iron is the most first intensively used formal iron in architecture.

Cast iron is term typically associated with the most common gray iron. While cast iron may element iron it's actually an alloy containing 2-4 percent carbon, so with evaluation of iron in the building material what happen it was carbon is being slowly added which will the enhances properties. So steel is nothing but added and alloy of iron and carbon. So these is the started in the beginning itself. So its alloy 2-5 percent carbon, plus additional amounts of silicon and manganese.

Cast iron is formed by smelting iron ore, or melting pig iron (the product of iron ore extracting), and mixing with scrap metals and other alloy ingredients.

Cost iron, when compared to wrought iron or steel, is very brittle and comparatively hard and non-malleable. So iron when through various evolutionary processes. So initially cast iron is extensible used then slowly the other forms will iron and steel were able to use its disadvantages and hence slowly it was not used in building industry. So even though it lost its significant in the building industries still being extensively used in making cooking were and its applications.

Cast iron applications:

So will look at the brief history and we have look at its applications.

Cast iron has a number of applications n the culinary field. So being replaced other form of iron and steel it now being reduced to domestic applications. It is used to make pots and pans and all sorts of utensils that are used for heating purposes. So you note is iron able to were a lot of temperature has a very high melting point that makes it viable in terms of application heat is involved. This is because the cast iron surface distributes the heart from the stone evenly all over its surface. So it's able to basically convert the heat and spread it all over its surface for making it very incentive.

Besides this, cast iron is widely used in piping applications, engines, and parts of automobiles and were earlier used in building bridges. So that side the first example first example there are studio for the iron is concerned.

We look at the image the arch bridge the iron bridge this is very famous. It is completely made from cast iron in the hut success during that age.

So apart from that it also has widespread use in architecture and buildings beginning from small applications to that of being full fledged structural units and support. So initially when steel its not actually discovered in used extensively. When various forms of irons is this cast iron is extensively used cast iron is important architecture features. Not only that the architecture features in terms of small application also used in the structural applications.

So the bridge so this is the very good example and how it can be very viable in terms of structural iron. It can also be long lasting durable the various features and various advantages of iron were very significantly shown in the building of the one bridges itself.

Cast iron has been used for centuries and was used in architecture in the pre-modern period for instance, so even in India it has a applications "Konark Sun Temple" were it has iron beams. So iron

beams Konark Sun Temple is something that was very historical significant shows the use of iron during very early suggests of history.

And one of the most important projects was the iron bridge in Shropshire.

Cost iron was first used in pagoda construction in Tang Dynasty China. So it was not just restricted to some particular error or some particular area geographically it was been slowly discovered in various areas and an also used parallely. So we looked at been used in India we now look at been used in china. The commissioner's house of the Royal Naval Dockyard, Bermuda designed by Edward Holl and built in the 1820s is considered to be the first residence that used cast iron in its structural framework. So as said apart from being small application in architecture it is been used structurally.

So one such example royal naval dockyard were is structural frame work in an important application. So this is that building so its long life is very significant its be able to stand all these days and been viable in the present day. You can see there is being used that can be shaped in the structures. It has structural application is well. so we looked at cast iron architecture is used in many intension and history as for is India, china and England this concern. So we loves look at why this cast iron became an important material.

In the 1850s the cheapness and available of cast iron led to advocating and designing buildings so cast iron being extremely available and being cheap at made as viable building this concern. So it is extensibility used. Cast iron could be cast into a wide array of shapes and designs, allowing elaborate facades that were far cheaper than traditional stone-carved ones. So that architecture was largely restricted to stone building research. So cast iron became an important material as for as cheap and availability to concern. What made it all the more further viable was it to be change or made into various different shapes. Which is extremely difficult as forest stone is concern stone buildings details lot of caving, lot of time, lot of labour in also lot of cost. But when cast iron was introduce was all gradually very extensively reduced which makes an viable building material. Which why became very easily used in all past the world.

These facades could also be painted a wide array of colours. So apart from just being used directly as a material it is also added to many ecstatic values in coloured to building. So painting cast iron material was very easy. So these like to be opening of the advent of painting of the hazards of building so giving coloured to the hazard of building. Many of these buildings had elaborate neo-classical or Romanesque designs. So these added to the various building style or the Romanesque design being developed that time all the nations an all that. Which is made viable that cast iron was the more relevant material has it to be used in terms of colour. Colour is not exactly very wide option as forest own building concern. In the late 19th century modern steel was developed, and it proved far more suitable than cast iron for structural and support purpose. So this steel did come rot iron to great extern. But before steel was introduced cast iron was by far the most suitable and easily available material. The fashion fore cast iron facades also faced in this era. So what happen this wine steel introduced it was made easily viable it was found to have more better properties. It became very clear that these fashions start gradually reduced designer.

Wrought iron:

So that we move on cast iron to wrought iron, so wrought iron was the next evolutionary step of iron and one of the most significant famous example in the Eiffel tower in parries. This is post to be the most photograph most famous land for landmark for this architecture are even any history is concern. And an important building material featured in Eiffel tower is that wrought iron.

So we look at wrought iron briefly. Wrought iron is an alloy with a very low carbon. So that carbon is being slowly mixed and used iron to make it more enhanced and having more lot of physical properties.

So wrought iron is the alloy with very low carbon content in contrast iron. It is a semi-fused mass of iron with fibrous slag inclusions which gives it a "grain" resembling wood, so when compared to cast iron which is pig iron which is has very flat to smooth feel this has a more grainy feel to it. That is visible when it is etched or bent to the point failure.

So wrought iron is tough, malleable, ductile, corrosion-resistant and easily welded. So you see apart from just being tough material in self adding an alloy and making it alloy in terms of using carbon makes it tough makes it malleable, ductile. So it changes all the disadvantages pig iron of it being brittle of being less durable so all that being converted enhanced. So wrought iron is actually tough its actually malleable its ductile its corrosion resistant and easily welded. Before the development of effective methods of steelmaking and the availability of larger quantities of steel, wrought iron was the most common form of malleable iron. So just before the advent of steel in the building industries, Wrought iron was the most used or the most effective building material.

So apart from being extensively in building and architecture the most important use it wrought iron found was in what time and world worth's. So most of the ware weapon such the ware building the temperature atmosphere is all made from wrought iron, so that was the direct application of wrought iron.

Wrought iron Puddling:

So wrought iron was basically made by Puddling and the Puddling Furnace was the most important process in which gives used. So what happens is cast iron and pig iron which is the direct material from which wrought iron is used. Where it heated to extern Were it reaches material melting point and become liquid after which its Puddle then taking separately and it is cool to found wrought iron. So you can look at this picture were making wrought iron was usually as shown. So you have a coal which is heated to give you the heat.

What happen is in this case of cast iron, pig iron the heat are fired or the frame was directly expose to the cast iron, pig iron. In this case only the heat or temperature was exposed to the material which added to the enhanced properties. So the coal was the brighter and iron was brighter the heat was supplied and air was added to it be properly heated. So this is the Puddling Furnace and how wrought iron was essentially made.

Wrought iron properties:

We will now look at this some properties which make it wonderful material. So wrought iron is actually soft it is ductile it is drawn in to be steels or alloys. It was magnetic which like to the magnetic industries slowly developing.

It is strong – high elasticity and tensile strength. So strength was an important material for any structural requirement for material is to be structurally viable have to durability and strength.

It was malleable drawn in the seats so malleable can be heated and reheated and worked into various shapes. So when you use a particular material in building industry as well as any domestrial applications that matter. It has to be able to adapt to various shapes and should be able to be done very easily. So malleability is a important future of the iron.

It becomes stronger the more it is worked. So the more you work a particular material it has to with stand the working and workability. A wrought iron was one such material which would handle the workability.

It suitable for members in tension or compression, so slowly it moves to be an important structural material so it was able to handle the tension and compression which made it structurally viable. So as for as cast iron was concern cost iron suitable for members in compression only adding alloys some making it alloys made it viable for more uses.

So other famous example is that of the wrought iron gates. The wrought iron gates working an pales England when important and more degraded gates for degraded application. Which is talk about various properties it was soft and ductile it could be malleable it is very durable it could strong corrosion. So all that can be shown in the single application, so it been integrity carbon used it is totally exposed to weather it is been able strong durably it is strong. So it strength concern to count.

Wrought iron properties:

Historical uses during the seventeenth and eighteenth centuries were typically decorative and included – Fences, gates and railings, balconies, porches and verandas. So you can see just being domestic application material its slowly of it being very slowly in important building material. It was uses in fences, gates and railing. So all the building component was soon being used by wrought iron balconies, porches and verandas. Also canopies roof cresting, lamps, grilles, hardware. So wherever it could be a ply and wherever it found its application useful and wrought iron was being it's sensibly used which made it one of the most important or widely used materials during that error.

Historical uses during the nineteenth century were more structural and included: nails and iron cramps. So apart from being structural the main structural frame work. It was also able to become an important material sixteenth in the structural frame work. Like in the case of nails and iron cramps structural members.

So the famous applications – the Eiffel tower and 13th century wrought iron gates of Westminster abbey in London. So it a talking about the Westminster abbey gates of wrought iron is very famous.