LECTURE 010

Innovations in living – by the ancient civilians

Role of intuition, innovation, inventiveness, creativity and ingenuity in construction

During the growth of the ancient civilizations, ancient technology was the result from advances in engineering in ancient times. These advances in the history of technology stimulated societies to adopt new ways of living and governance. The Empires may have fallen more than 1,500 years ago, but its rich legacy of innovation and invention can still be seen today. The ancient civilians were prodigious builders and expert civil engineers, and their thriving civilization produced advances in technology, culture and architecture that remained unequaled for centuries.

1. Aqueducts

The Romans enjoyed many amenities for their day, including public toilets, underground sewage systems, fountains and ornate public baths. None of these aquatic innovations would have been possible without the Roman aqueduct. First developed around 312 B.C., these engineering marvels used gravity to transport water along stone, lead and concrete pipelines and into city centers. Aqueducts liberated Roman cities from a reliance on nearby water supplies and proved priceless in promoting public health and sanitation. While the Romans did not invent the aqueduct—primitive canals for irrigation and water transport existed earlier in Egypt, Assyria and Babylon—they used their mastery of civil engineering to perfect the process. Hundreds of aqueducts eventually sprang up throughout the empire, some of which transported water as far as 60 miles. Rome's famous Trevi Fountain, for instance, is supplied by a restored version of the Aqua Virgo, one of ancient Rome's 11 aqueducts.

2. Concrete

Many ancient Roman structures like the Pantheon, the Colosseum and the Roman Forum are still standing today thanks to the development of Roman cement and concrete. The Romans first began building with concrete over 2,100 years ago and used it throughout the Mediterranean basin in everything from aqueducts and buildings to bridges and monuments. Roman concrete was considerably weaker than its modern counterpart, but it has proved remarkably durable thanks to its unique recipe, which used slaked lime and a volcanic ash known as pozzolana to create a sticky paste. Combined with volcanic rocks called tuff, this ancient cement formed a concrete that could effectively endure chemical decay. Pozzolana helped Roman concrete set quickly even when submerged in seawater, enabling the construction of elaborate baths, piers and harbors.

3. Newspapers

The Romans were known to contribute to public discourse through the use of official texts detailing military, legal and civil issues. Known as Acta Diurna, or “daily acts,” these early newspapers were written on metal or stone and then posted in heavily trafficked areas like the Roman Forum. Acta are believed to have first appeared around 131 B.C. and typically included details of Roman military victories, lists of games and gladiatorial bouts, birth and death notices and even human interest stories. There was also an Acta Senatus, which detailed the proceedings of the Roman senate. These were traditionally withheld from public view until 59 B.C., when Julius Caesar ordered their publication as part of the many populist reforms he instituted during his first consulship.

4. Welfare

Ancient Rome was the wellspring for many modern government programs, including measures that subsidized food, education and other expenses for the needy. These entitlement programs date back to 122 B.C., when the tribune Gaius Gracchus instituted lex frumentaria, a law that ordered Rome’s government to supply its citizens with allotments of cheaply priced grain. This early form of welfare continued under Trajan, who implemented a program known as “alimenta” to help feed, clothe and educate orphans and poor children. Other items including corn, oil, wine, bread and pork were eventually added to the list of price-controlled goods, which may have been collected with tokens called “tesserae.” These generous handouts helped Roman emperors win favor with the public, but some historians have argued that they also contributed to Rome’s economic decline.

5. Bound Books

For most of human history, literature took the form of unwieldy clay tablets and scrolls. The Romans streamlined the medium by creating the codex, a stack of bound pages that is recognized as the earliest incarnation of the book. The first codices were made of bound wax tablets, but these were later replaced by animal skin parchment that more clearly resembled pages. Ancient historians note that Julius Caesar created an early version of a codex by stacking pages of papyrus to form a primitive notebook, but bound codices did not become popular in Rome until the first century or thereabouts. Early Christians became some of the first to adopt the new technology, using it extensively to produce copies of the Bible.

6. Roads and Highways

At its height, the Roman empire encompassed nearly 1.7 million square miles and included most of southern Europe. To ensure effective administration of this sprawling domain, the Romans built the most sophisticated system of roads the ancient world had ever seen. These Roman roads—many of which are still in use today—were constructed with a combination of dirt, gravel and bricks made from granite or hardened volcanic lava. Roman engineers adhered to strict standards when designing their highways, creating arrow-straight roads that curved to allow for water drainage. The

Romans built over 50,000 miles of road by 200 A.D., primarily in the service of military conquest. Highways allowed the Roman legion to travel as far as 25 miles per day, and a complex network of post houses meant that messages and other intelligence could be relayed with astonishing speed. These roads were often managed in the same way as modern highways. Stone mile markers and signs informed travelers of the distance to their destination, while special complements of soldiers acted as a kind of highway patrol.

7. Roman Arches

Arches have existed for roughly 4,000 years, but the ancient Romans were the first to effectively harness their power in the construction of bridges, monuments and buildings. The ingenious design of the arch allowed the weight of buildings to be evenly distributed along various supports, preventing massive Roman structures like the Colosseum from crumbling under their own weight. Roman engineers improved on arches by flattening their shape to create what is known as a segmental arch and repeating them at various intervals to build stronger supports that could span large gaps when used in bridges and aqueducts. Along with columns, domes and vaulted ceilings, the arch became one of the defining characteristics of the Roman architectural style.

8. Battlefield Surgery

The Romans invented many surgical tools and pioneered the use of the cesarean section, but their most valuable contributions to medicine came on the battlefield. Under the leadership of Augustus, they established a military medical corps that was one of the first dedicated field surgery units. These specially trained medics saved countless lives through the use of Roman medical innovations like hemostatic tourniquets and arterial surgical clamps to curb blood loss. Roman field doctors also performed physicals on new recruits and helped stem the spread of disease by overseeing sanitation in military camps. They were even known to disinfect instruments in hot water before use, pioneering a form of antiseptic surgery that was not fully embraced until the 19th century. Roman military medicine proved so advanced at treating wounds and promoting wellness that soldiers tended to live longer than the average citizen despite constantly facing the hazards of combat.

9. Written language

The use of drawings to tell stories is certainly nothing new; cave paintings found in France and Spain date all the way back to 30000 B.C. But drawings and paintings wouldn't evolve into the first written language for thousands of years, when the first writing systems arose out of Egypt and Mesopotamia.

The Egyptian writing system began with pictograms, the first of which date back to 6000 B.C. Pictograms were simple depictions of the words they represented, but they had limitations. Over time, Egyptians added other elements to their writing system, including alphabet like characters that stood for certain sounds and other characters, allowing them to write out names and abstract ideas.

Today, everyone knows the Egyptians for the creation of hieroglyphics, which contained a mixture of alphabetic, syllabic symbols, as well as ideograms -- pictures that stood for whole words -- found extensively within Egyptian tombs and other places. The writing tells tales of war, politics and culture that give us a great understanding of ancient Egyptian society. Of course, we have the Rosetta stone to thank for our ability to interpret the writing. Its discovery, along with the work of French scholar Jean-Francois Champollion to decode the stone, marked the end of a 1,500-year-period during which Egyptian writing was shrouded in mystery.

10. The Plow

While historians aren't entirely certain of where the plow originated, evidence suggests that the Egyptians and Sumerians were among the first societies to employ its use around 4000 B.C. Those plows certainly had room for improvement. Likely built from modified hand tools, the plows were so light and ineffective that they are now referred to as "scratch plows" for their inability to dig deep into the ground. What's more, the plows ran on nothing more than elbow grease. For instance, wall paintings illustrate four men pulling a plow through a field together -- not a great way to spend a day in the scorching Egyptian sun.

That all changed in 2000 B.C., when the Egyptians first hooked their plows to oxen. Early designs were connected to the horns of cattle but proved to interfere with the animal's ability to breathe. Later versions incorporated a system of straps and were much more effective. The plow revolutionized farming in ancient Egypt and, combined with the steady rhythm of the Nile River, made farming easier for the Egyptians than perhaps any other society of the time.

11. Door Lock

Whenever you lock your door at night and slide the deadbolt into place, say a prayer of thanks for the ancient Egyptian invention of door locks. The earliest such device, created around 4000 B.C., basically was a pin-tumbler lock, in which a hollowed-out bolt in the door was connected to pins that could be manipulated by insertion of a key. When the key pushed upward on the pins, they slipped away from the bolt shaft, allowing it to be withdrawn.

One drawback of these ancient locks was their size. The biggest ones were up to 2 feet (0.6 meters) in length. Egyptian locks actually were more secure than the technology later developed by the Romans, who used a simpler design with a spring rather than a bolt to hold the door in place. The Roman locks were hidden inside the door, but compared to the Egyptian locks, they were relatively easy to pick.

12. Water Mill

Not so long ago, water mills were a revolutionary invention used all over the world for the purpose of metal shaping, agriculture and most importantly, milling. To mill meant to grind, and that invariably meant to grind grain. This in turn led to production of edible food staple like beaten rice, cereals, pulses, flour and so on. Ever since its origination, water mill has seen a number of subsequent variations, which enabled people to use its milling features into different raw materials. These mills are still used in many parts of the rural world to serve similar purposes.

This useful invention takes its roots of origination from the earliest known Perachora wheel, created way back in 3rd century BC Greece, most likely by the contemporary Greek engineer Philo of Byzantium. Earlier, the portions of the mechanical treatise on this particular water mill written by Philo himself were regarded to have Arab origination. But recent researches by British historian M.J.T. Lewis proved that water mill has an authentic ancient Greek origin.

13. Cartography

Cartography is the study and practice of making maps. It has played an important role in travel and navigation since ancient times. Even though the earliest known evidences of cartography points towards the ancient Babylon in a time as early as the 9th century BC, the Greeks took, what they had at their disposal and brought cartography into new light and possibilities. Anaximander was one of the pioneer cartographers to create the map of the world. Born between 611-610 BC, this map maker of the ancient world made important contributions to the sciences of astronomy and geography.

This map maker finds his mention in Aristotle's work, who categorized him as the pupil of the physical school of thought, propounded by Thales. A reputed cartographer, Anaximander presented the inhabited regions in his map of the world. The map appeared in tablet and featured Ionia in the center. The world map bounded on the east by the Caspian Sea. It stretched to the Pillars of Hercules in the west. Middle Europe borders the map in the North while Ethiopia and the Nile featured at the southern end of the map of Anaximander. He made immense contributions in the field of cartography and geography and his map of the world was indeed a marvelous achievement of that time.

14. Olympics

The modern Olympics are one of the greatest spectacles in sports of the modern age. But when Pierre de Coubertin, the founder of the international Olympic committee started the first modern Olympic in 1896, he was extensively inspired by the ancient Olympics that used to be held in ancient Greece more than 2700 years ago. According to historical records, the first ancient Olympic Games can be traced back to 776 BC. They were dedicated to the Olympian gods and were staged on the ancient plains of Olympia. The Isthmos game was staged every two years at the Isthmus of Corinth. The Pythian games took place every four years near Delphi. The most famous games held at Olympia, South- West of Greece, which took place every four years. People from all over the Greek came to witness the spectacle. The victors were given olive leaf wreaths or crowns as a prize.

15. Crucible steel and Natural fibers

High-quality steel has been produced in South India since ancient times. The technique used to manufacture it was later on called the crucible technique. Pure wrought iron was first put together with glass and charcoal in a container and was heated till the metal melted and absorbed the carbon. Natural fibers like wool, cotton and plant originated from India. Evidences show that people of the Indus Valley used cotton and India pioneered the art of cotton spinning and used it in making fabric. Jute, a plant fiber, was cultivated in India since ancient times and was later exported to other countries. Cashmere wool, which is supposed to be the finest wool was first made in Kashmir and was used to make hand- made shawls. These shawls have maintained their richness and exclusivity even today.

The evolution of master builders and emergence of world masterpieces:

Architect Imhotep and Pyamid of Djoser

Nebuchandnezzar II and the beauty of "The Hanging Gardens"

Apollodorus of Damascus – The epic of Pantheon

Ictinus and Callicratus – The Parthenon

Basic civilization to the city formation – Harappan culture

Harappan architecture is the architecture of the Harappans, an ancient people who lived in the Indus Valley from about 3300 BCE to 1300 BCE. The Harappans were advanced for their time, especially in architecture.

Each city in the Indus Valley was surrounded by massive walls and gateways. The walls were built to control trade and also to stop the city from being flooded. Each part of the city was made up of walled sections. Each section included different buildings such as: Public buildings, houses, markets, craft workshops, etc.

The Harappans were excellent city planners. They based their city streets on a grid system. Streets were oriented east to west. Each street had a well-organized drain system. If the drains were not cleaned, the water ran into the houses and silt built up. Then the Harappans would build another storey on top of it.

Although not every Harappan house had a well, they are quite common and comprise one of the most recognizable features of Harappan urbanism. Over the years, the level of streets and houses were raised owing to the accumulation of debris which necessitated raising the height of the wells.

- Houses and other buildings were made of sun-dried or kiln-fired mud brick. These bricks were so strong; they have stood up to thousands of years of wear.
- Each house had an indoor and outdoor kitchen. The outdoor kitchen would be used when it was warmer (so that the oven wouldn't heat up the house), and the indoor kitchen for use when it was colder.
- In present day, village houses in this region (e.g. in Kachchh) still have two kitchens. Indoor kitchens are used mostly as store houses and are only used for cooking when it rains. Otherwise, residents prefer to use the outdoor kitchens because the dry shrub and cow dung used as cooking fuel are very smoky, making indoor cooking difficult.
- So far, no unequivocal examples of temples have been found at sites belonging to the Indus Valley Civilization. Archaeologists do not know yet what religion was practiced in the Indus Valley Civilization.
- Community water pools (swimming or bathing) do exist, which may be linked with religious practice. Water plays an important role in Hindu sacred places, and pilgrimage to such places often involves sacred bathing (apart from the Ganges).