

Modern construction Technique

Organized by
Bahiru Bewket (PhD)
Assistant Professor
bahirdire@gmail.com

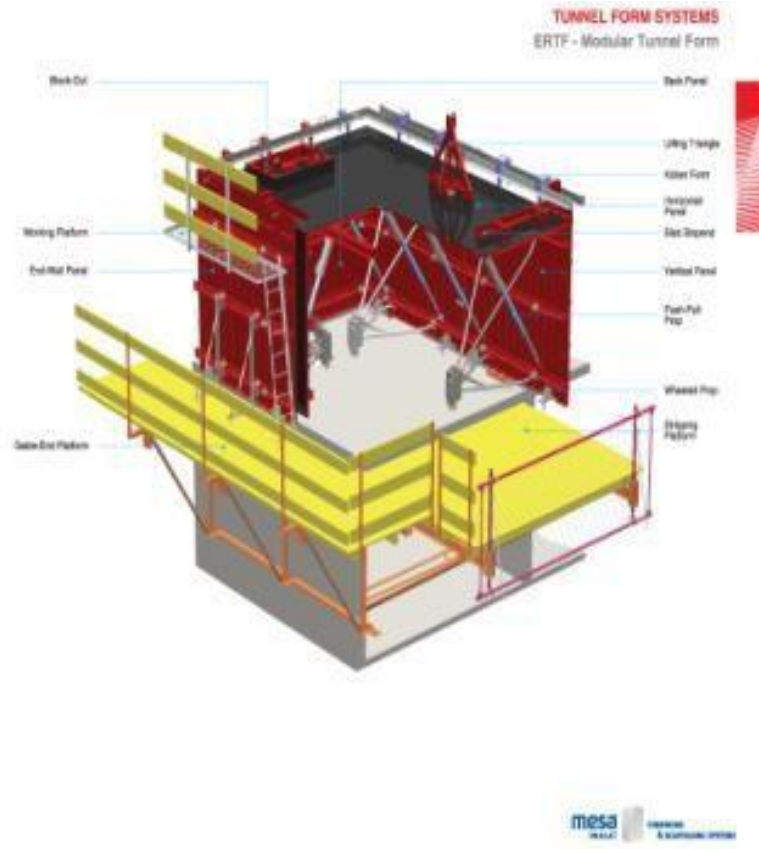
Seminar

- 1. Sustainable Construction and Resources utilization and efficiencies**
- 2. Building Information Modelling (BIM) and its procurement delivery system**
- 3. Constructability of Civil Engineering Construction**
- 4. Application of Lean construction in construction industry**
- 5. Fiber reinforced concrete**
- 6. Form work, scaffold and false work**
- 7. Ground improvement & dewatering**

Lecture 1 - Introduction

INTRODUCTION

- What is modern construction?
- What make construction industry modern?



INTRODUCTION

- **Building Information Modelling (BIM)**



INTRODUCTION

- **BIM is an intelligent 3D model-based process that gives architecture,**
- **engineering, and construction (AEC) professionals the insight and tools to more efficiently plan, design, construct, and manage buildings and infrastructure.**



INTRODUCTION

- Construction industry has evolved from ***traditional*** to ***Modern Method***
- Construction (MMC) during last few decades.
- ***on-site construction methods*** has changed toward:
 - ***Industrial production.(pre-cast component &/pre-cast whole)***
 - ***3D Printing***
- The decision to build a project by MMC is usually motivated in part by the need to meet deadline of schedule (fast erection), to spend minimum cost, to minimize waste generation, but to achieve high quality project production.

INTRODUCTION

- Traditional management methods like *schedule bar chart* and *critical path methods* (CPM) may not be suitable for planning and controlling project resources.
- MMC falls into the following categories:
 - **1. Off-site Manufacture** (OSM): The part of the production process that is carried out away from the building site in factory conditions. Examples include: Rapid wall/Panel Building Systems; Volumetric (also known as *Modular Construction*); Hybrid (also known as Semi-Volumetric); Sub-Assemblies and; **Components/pre-stressed**
 - **2. Non Off-site Manufacture**: innovative methods of construction used on-site and the use of conventional components in an innovative way. Examples include: ***posted-tensioned, fiber, admixtures...***

INTRODUCTION

- Identifying inefficient activities and valuable improvement in the process of *on-site construction* is vital by designing modern powerful planning and controlling **tools**.

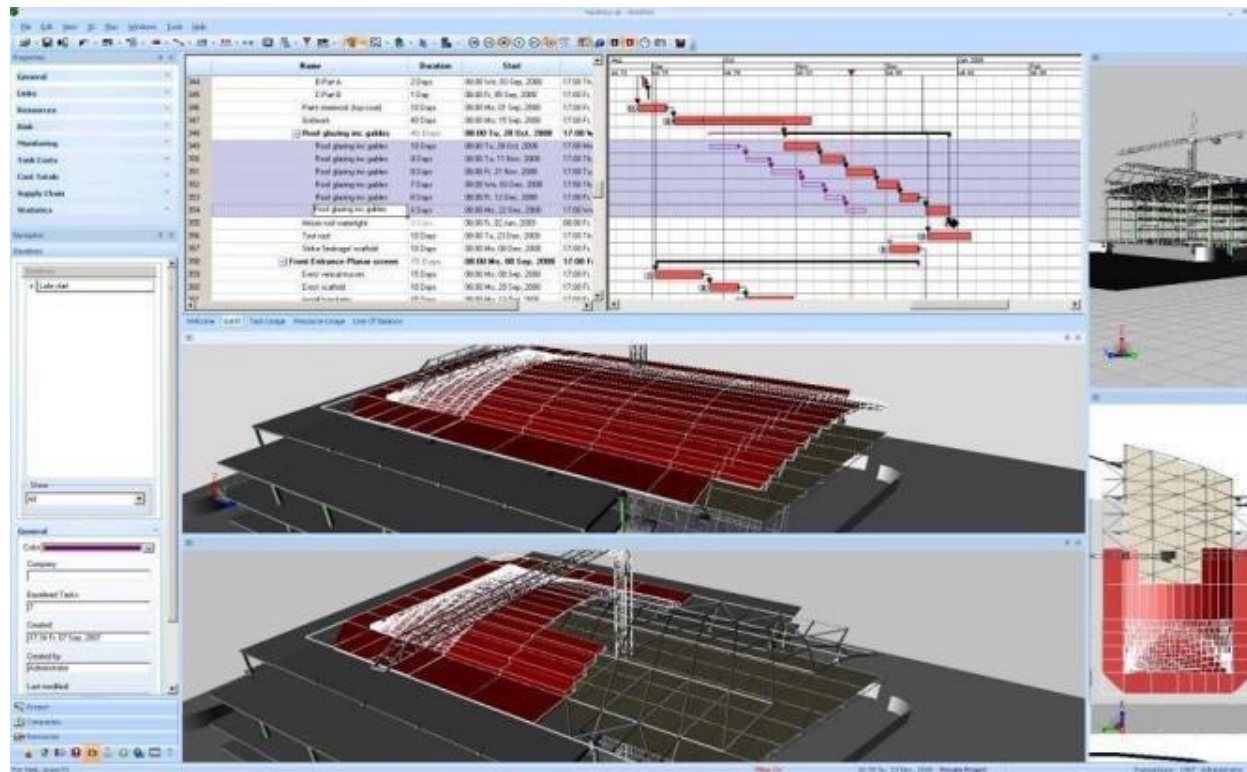
1. Simulation

- Simulation modelling is a tool which enables project participants to experiment the different methods of constructing even without attending project sites.

INTRODUCTION

2. Visualization

- 2.1. Activity base visualization(4D CAD)



INTRODUCTION

Operation base Visualization Planning

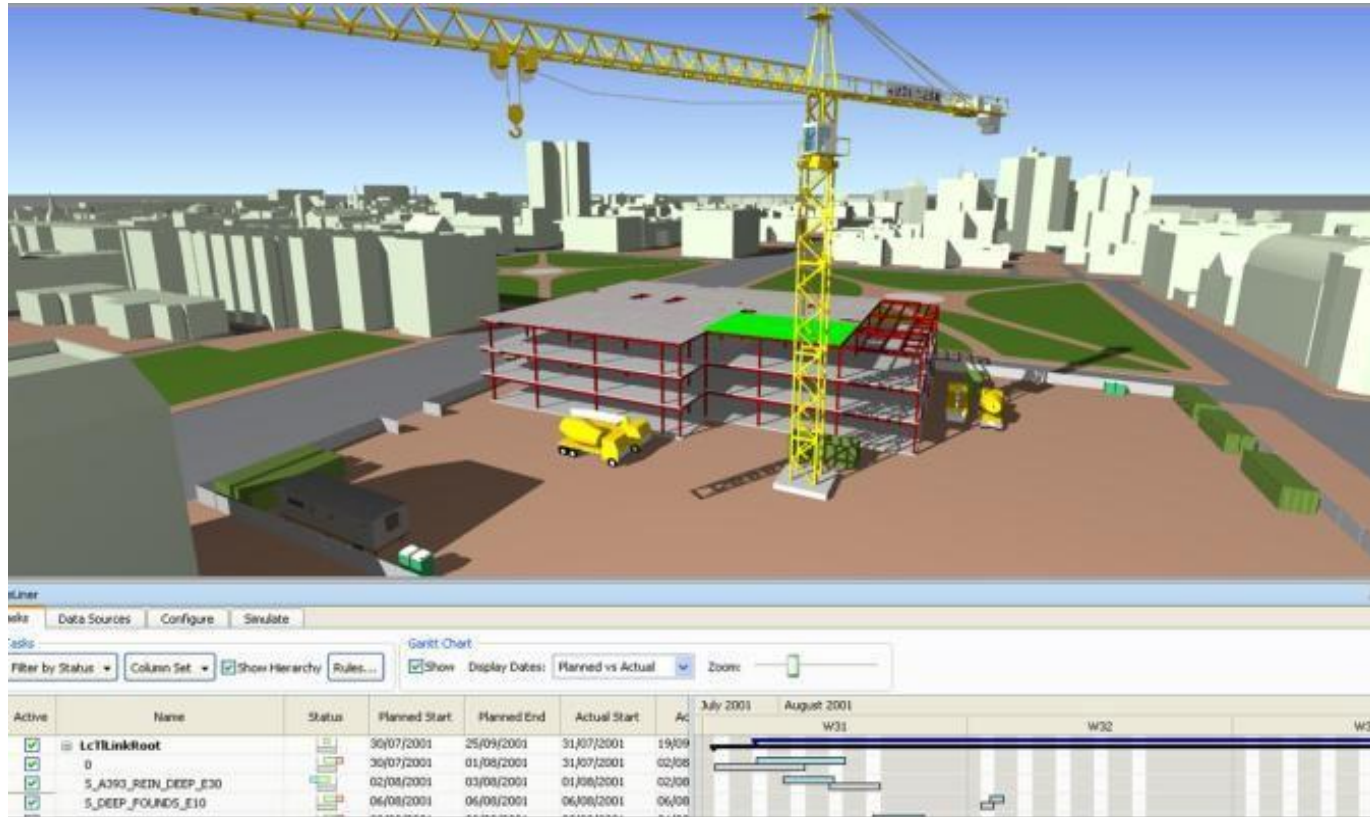


Figure : Visualization of construction operation in virtual Reality

INTRODUCTION

- *Figure : 3D reconstruction of as-built project by 2D photos (Structure of Motion Techniques)*



Figure : 3D reconstruction of as-built project by 2D photos (Structure of Motion Techniques)

INTRODUCTION

- Development and stages in construction technology, where are we and current state of construction technology
 - ✓ What is construction technology?
 - ✓ Method of construction
 - ✓ Type of equipment
 - ✓ Type material



INTRODUCTION

What is construction Technology?

- Technology is the making, modification, usage, and knowledge of tools, machines, techniques, crafts, systems, methods of organization, in order to solve a problem, improve a *preexisting solution to a problem*, achieve a goal or perform a specific function.
- Future development of construction technologies depends on the most pressing needs of sustainable built environment, economic and business fragmentation constraints.
- characteristic for the construction industry, and the need to increase productivity and safety of construction workers.

Development and stages in construction technology, where are we and current state of construction technology

- Building technologies and trades developed at first, most likely in ancient Mesopotamia (in the Tigris- Euphrates river system), dating back to year 3600 BC.
- Ancient Egyptian pyramids of Giza, whose construction lasted only approximately 20 years and concluded in approximately year 2560 BC,
- The exact means and methods of their construction, ranging from ancient forms of *in situ* processes to those partially resembling offsite prefabrication.

INTRODUCTION

- **Ancient Maya** construction of Central America, featuring ceremonial platforms, palaces, pyramids, temples, observatories and ball-courts had intricate carved stones and stair-step design, spanning a vast period of several thousands of years.
- **Ancient Greece** and **ancient Roman** Empire borrowed a number of building techniques from the preceding civilizations while also developing unique techniques and architectural styles of their own, characterized by numerous temples, palaces and other public and private buildings, as well as world-renown structures such as Parthenon in Athens or Colosseo stadium in Rome.

INTRODUCTION

- Construction techniques of parabolic stone arches ***subjected to compression forces only***, with no bending moments, and the design and construction of elevated municipal.
- New materials and techniques, including the production and implementation of building glass and an apparent use of organic mortars for ***stone masonry***.

Introduction-Linking the Present to the Past

History: Development and stages in construction technology in Ethiopia

World Heritage Sites in Ethiopia:

- Aksum,
- Fasil Ghebbi,
- The Fortified Historic Town of Harar Jugol,
- Konso Cultural Landscape,
- Rock-Hewn Churches of Lalibela



Linking the Present to the Past

- The invention of Portland cement and the production of concrete revolutionized the use of construction materials and techniques and the ensuing construction methods dominate to this day.
- There is some historical evidence that this technology dates back to the ancient Romans and was used in the Roman Empire, e.g. for construction of the **Roman Pantheon** (Mukerji 2005).



Introduction-Linking the Present to the Past

- Portland cement, arguably one of mankind's most important manufactured materials, was invented and patented by Joseph Aspdin from Leeds in 1824.
- The Egyptians used calcined gypsum as a cement and the Greeks and Romans used **lime made by heating limestone** and added sand to make mortar, with coarser stones for concrete.

Introduction-Linking the Present to the Past

- However, with the demise of that empire, the use of concrete was abandoned and almost forgotten, until its re-invention and slow reemergence from the 18th century AD onwards.
- *Currently the tallest building in the world, Burj Khalifa in Dubai (828 meters tall) is built with the use of this material.*

Introduction-Linking the Present to the Past

- The first concrete-like structures were built by the Nabataea traders or Bedouins who occupied and controlled a series of oases and developed a small empire in the regions of southern Syria and northern Jordan in around 6500 BC.



Introduction-Linking the Present to the Past

Egypt

- Around 3000 BC, the ancient Egyptians used mud mixed with straw to form bricks.
- The ***Great Pyramid at Giza*** required about 500,000 tons of **mortar**, which was used as a bedding material for the casing stones that formed the visible surface of the finished pyramid.



Fig. A pyramid casing stone

Introduction-Linking the Present to the Past

The Pantheon

- Built by Rome's Emperor Hadrian and completed in 125 AD, the Pantheon has the largest un-reinforced concrete dome ever built.



Introduction-Linking the Present to the Past

Ethiopian context

- Mad
 - “Chid” as binding
 - Egg shell as binding (Fasil palace)
 - Masonry (Portuguese bridge)
-  Addis light railway
 -  Industrial Parks
 -  Skyscraper building
 -  Tekeze Ach-Dam
 -  Gelgel Gibe (one of the tallest dam in Africa)



Introduction-Linking the Present to the Past

CBE-Head

4B+G+48



Technologies

1. Delivery method (DB) which is new for building in Ethiopia
2. Pre-fabrication
3. Concrete pumping
4. Different concrete class (C60 and C40)
5. Safety issue