Salahaddin University-Erbil

College of Engineering

Civil Department

3rd Year Students

Elective Course

(Computer Application-CAD Software)

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PhD. in Structural Engineering & Construction Materials

Spring Semester 2021-2022

ETABS Software

1-Introduction

ETABS is a powerful program that can greatly enhance an engineer's analysis and design capabilities for structures. Consists array of options and features and simple to use. The basic approach for using the program is very straightforward. The user establishes grid lines, places structural objects relative to the grid lines using joints, frames, links, tendons, and shells, and assigns loads and structural properties to those structural objects (for example, a frame object can be assigned section properties; a joint object can be assigned spring properties; a shell object can be assigned slab or deck properties).

Analysis, design, and detailing are then performed based on the structural objects and their assignments. Results are generated in graphical or tabular form that can be printed to a printer or to a file for use in other programs.

Behavior of load path gravity and lateral loads

- For Gravity Loads,

Analysis of Gravity Load Resisting System for:

Dead Load, Live Load, Pattern Loads, temperature, shrinkage

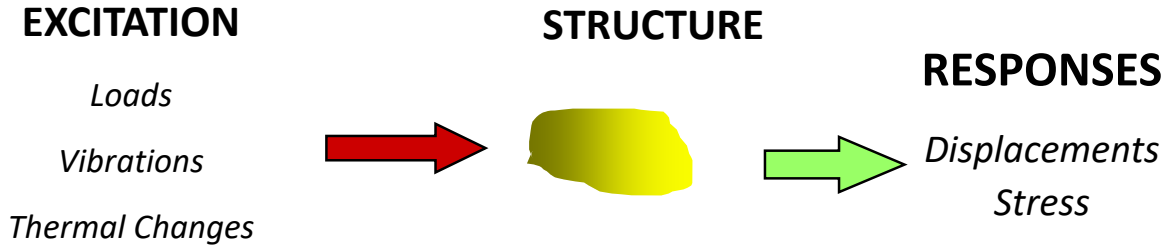
Important Elements: Floor slabs, beams, openings, Joists, etc.

- For Lateral Loads

Analysis of Lateral Load Resisting System for:

Wind Loads, Seismic Loads, Structural Un-symmetry

Important elements: Columns, shear walls, bracing, beams



The Need for Modeling

Real Structure cannot be Analyzed:

It can only be "Load Tested" to determine response

We can only analyze a "Model" of the Structure

We therefore need tools to Model the Structure and to Analyze the Model

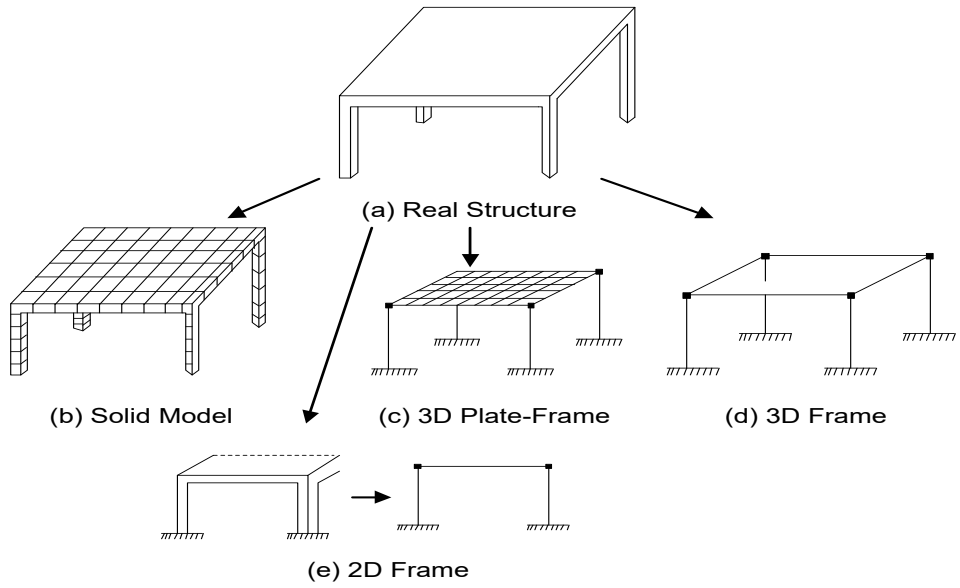
Finite Element Method: The Analysis Tool

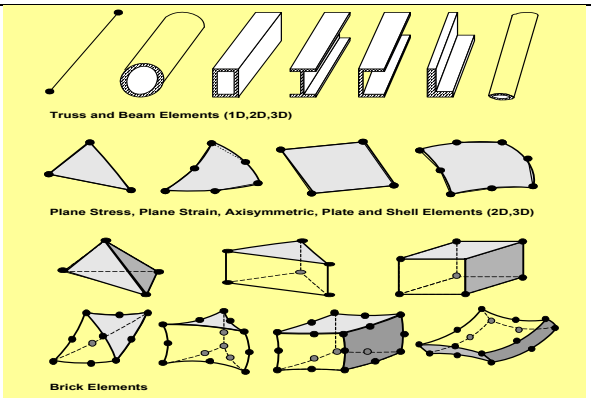
- Finite Element Analysis (FEA)

"A discretized solution to a continuum problem using FEM"

- Finite Element Method (FEM)

"A *numerical procedure for solving (partial) differential equations associated with field problems, with an accuracy acceptable to engineers"*



1 D Elements (Beam type) - Can be used in 1D, 2D and 2D - 2-3 Nodes. A, I etc. 2 D Elements (Plate type) - Can be used in 2D and 3D Model - 3-9 nodes. Thickness 3 D Elements (Brick type) - Can be used in 3D Model - 6-20 Nodes.	

Elastic Material

Follows the same path during loading and unloading and returns to initial state of deformation, stress, strain after removal of load.

Inelastic Material

Does not follow the same path during loading and unloading and may not returns to initial state of deformation, stress, strain after removal of load.

Most materials exhibit both, elastic and inelastic behavior depending upon level of loading.

Linearity

The response is directly proportional to load (Deflection doubles if load is doubled)

Non-Linearity

The response is not directly proportional to load (deflection may become 4 times if load is doubled

Structure, Member, Element

Structure can consider as an assemblage of Members

Slabs, Beams, Columns, Footings

Members can be modeled by using one or more Elements

1D elements, 2D element, 3D elements

Frame element, plate element, shell element, solid element, etc.

Modeling in terms Graphical Objects to represent Physical Components

Vertical Load Resisting Systems

Transfer Gravity Loads Applied at the Floor Levels down to the Foundation Level
Gravity loads: Self weight, Super imposed load, live load

Direct Path Systems

- Slab Supported on Load Bearing Walls
- Slab Supported on Columns

Ex. Flat Slab and Flat Plate, Waffle Slab

Indirect Multi Path Systems

- Slab Supported on Beams
- Beams Supported on Other Beams
- Beams Supported on Walls or Columns

Ex. (Beam, Slab), (Girder, Beam, Slab

Lateral Load Resisting Systems

Transfer Lateral Loads Applied at any location in the structure down to the Foundation Level

Lateral Loads

- Wind Load
- Seismic Load
- Horizontal component of Gravity Loads in Inclined Systems and in Un-symmetrical structures
- lateral soil pressure, liquid and material retention

Single System

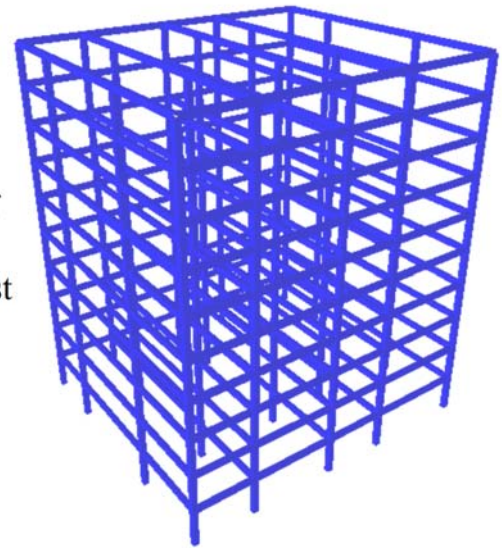
- Moment Resisting Frames
- Braced Frames
- Shear Walls
- Tubular Systems

Dual System

- Shear Wall - Frames
- Tube + Frame + Shear Wall

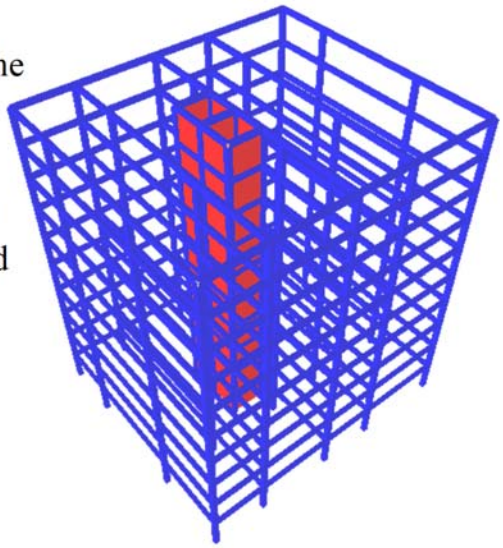
Moment Resisting Frame

- The Load is transferred by shear in columns, that produces moment in columns and in beams
- The Beam-Column connection is crucial for the system to work
- The moments and shear from later loads must be added to those from gravity loads



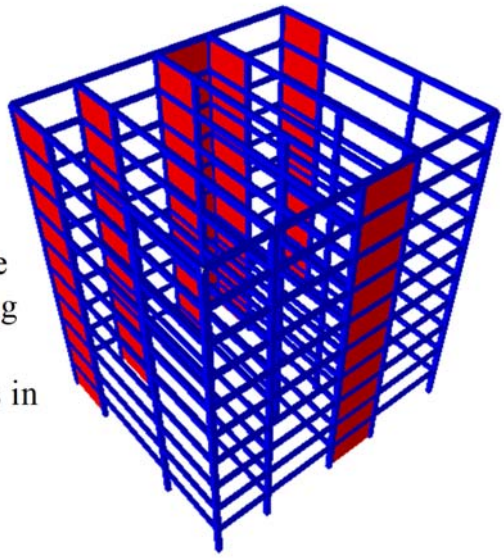
Shear Wall and Frame

- The lateral loads is primarily resisted by the shear in the walls, in turn producing bending moment
- The openings in wall become areas of high stress concentration and need to be handled carefully
- Partial loads is resisted by the frames



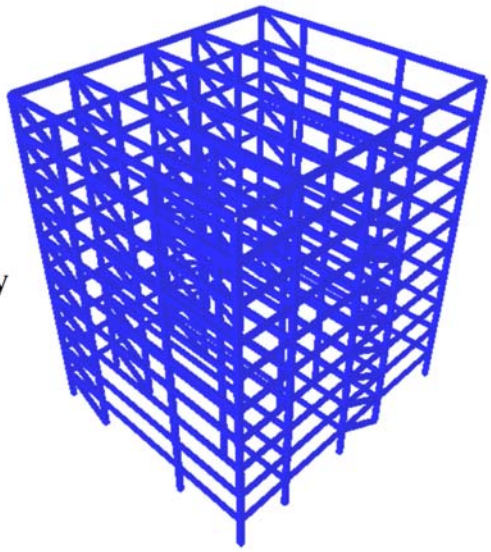
Shear Wall and Frame

- The Walls are part of the frame and act together with the frame members
- The lateral loads is primarily resisted by the shear in the walls, in turn producing bending moment.
- Partial loads is resisted by the frame members in moment and shear



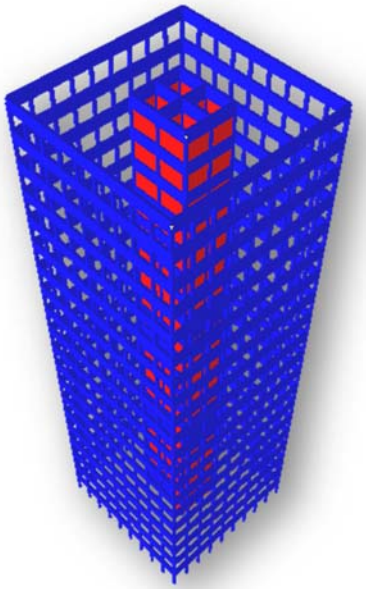
Braced Frame

- The lateral loads is primarily resisted by the Axial Force in the braces, columns and beams in the braced zone.
- The frame away from the braced zone does not have significant moments
- Bracing does not have to be provided in every bay, but should be provided in every story



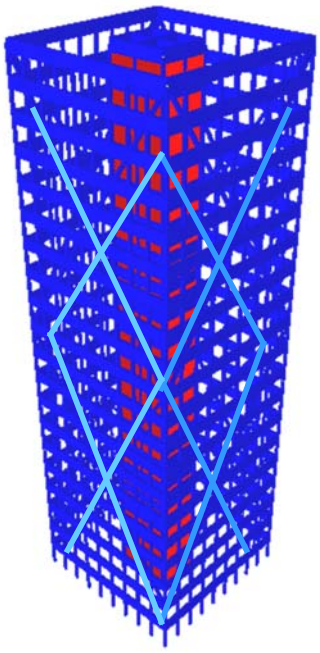
Tubular System

- The system is formed by using close spaced columns and deep spandrel beams
- The lateral loads is primarily resisted by the entire building acting as a big cantilever with a tubular/ box cross-section
- There is a “shear lag” problem between opposite faces of the tube due to in-efficiency of column beam connection



Braced Tube System

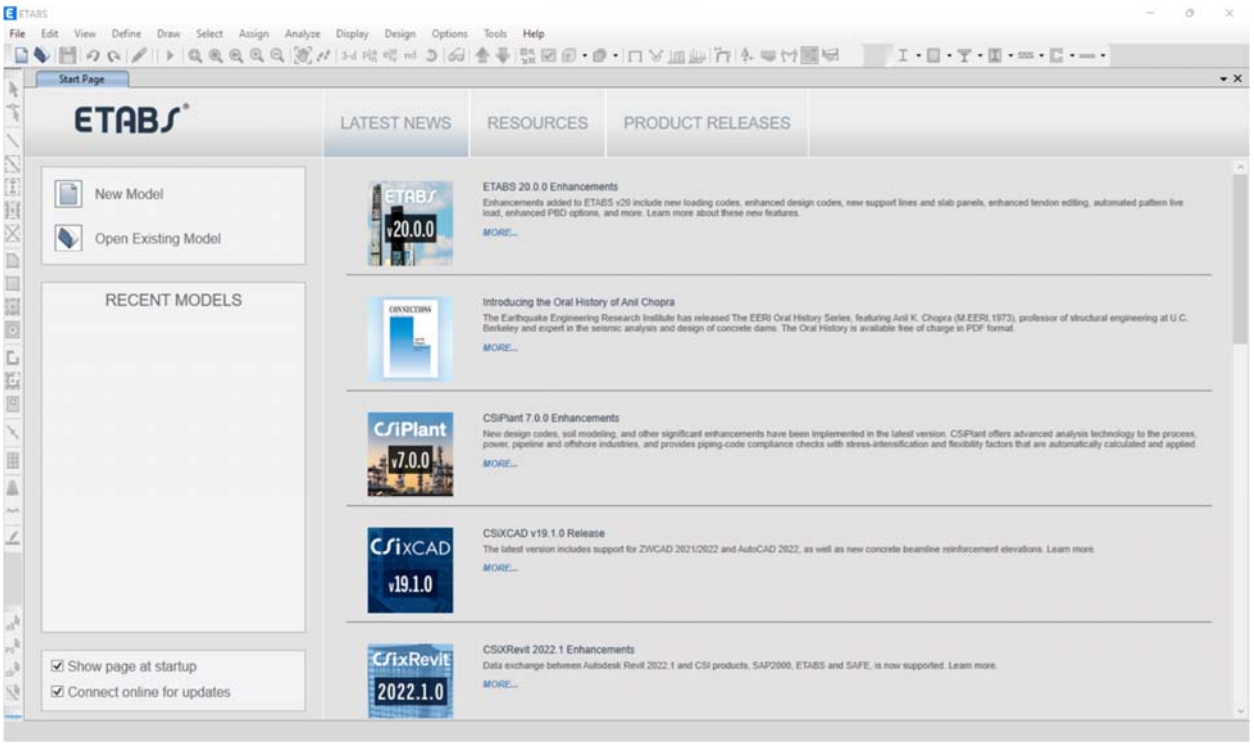
- Diagonal Braces are added to the basic tubular structure
- This modification of the Tubular System reduces shear lag between opposite faces



2-START WITH ETABS

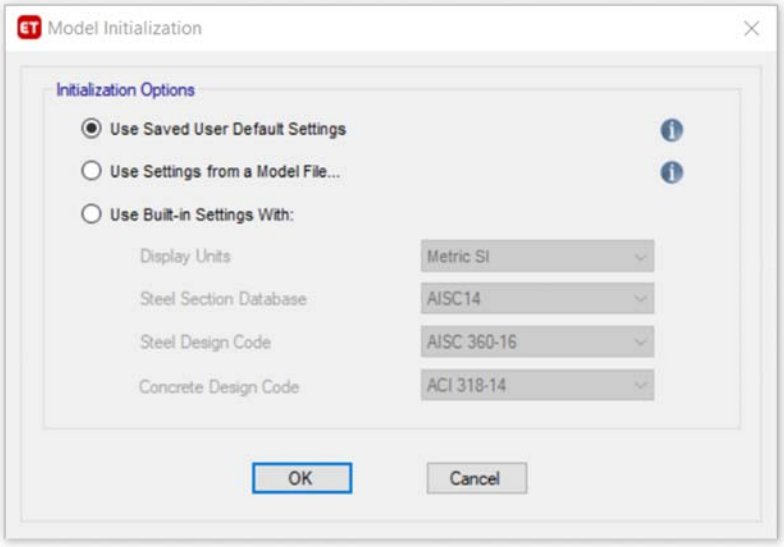
Main window

- Latest News: new versions, products of CSI company
- Resources: Learn ETABS videos, Manuals, Knowledge Base, Website.

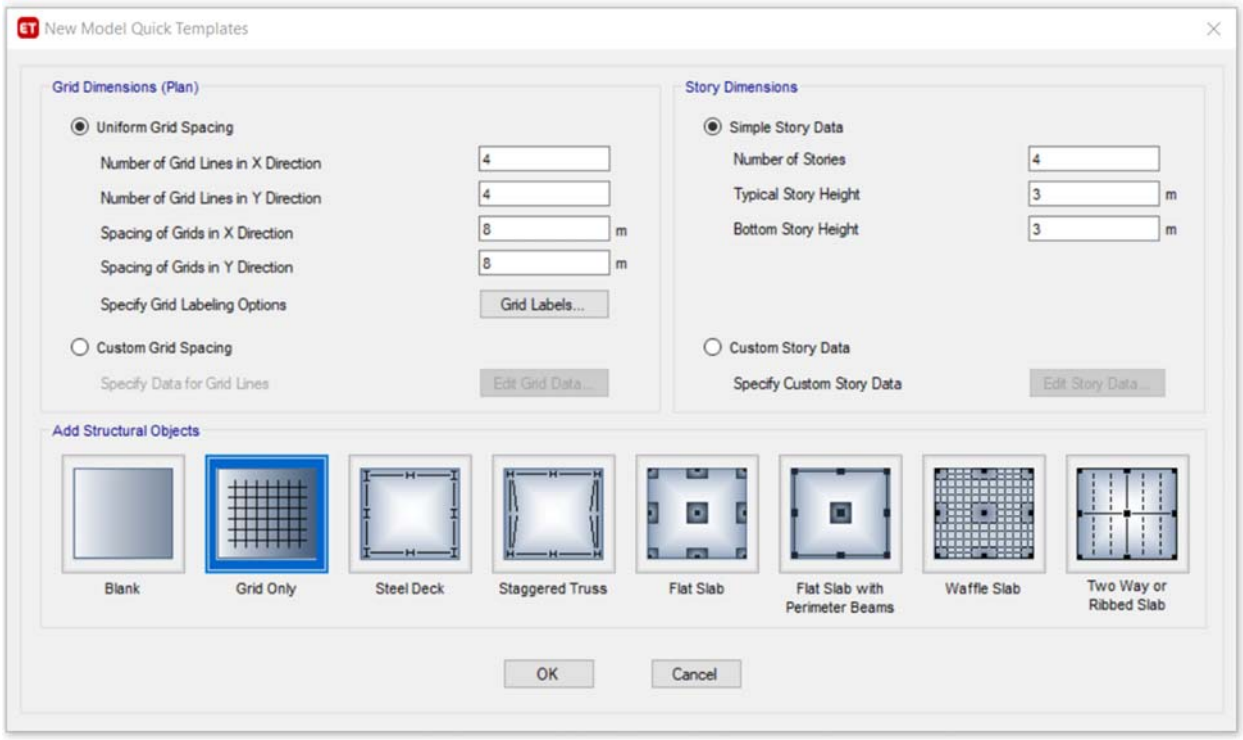


Open new model

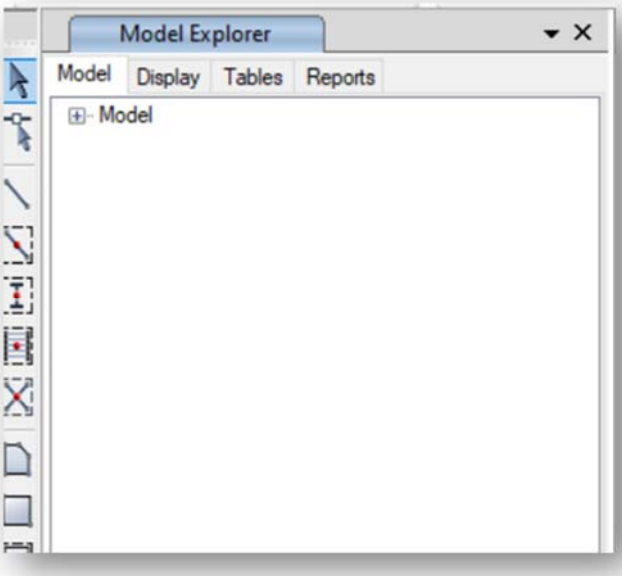
Select units and main code of design



According to structure element select a template

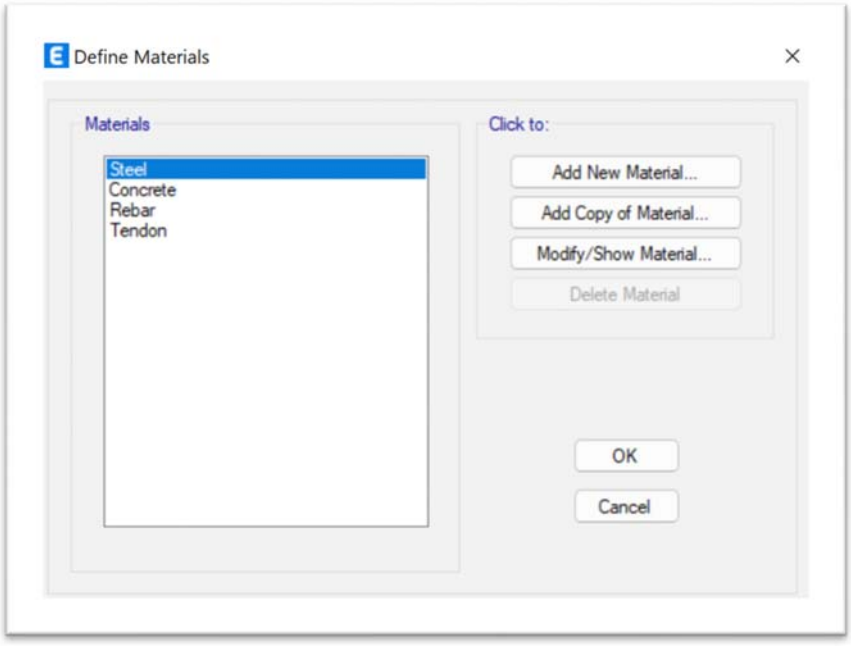


Model Explorer: (model, Display, Tables, Reports)



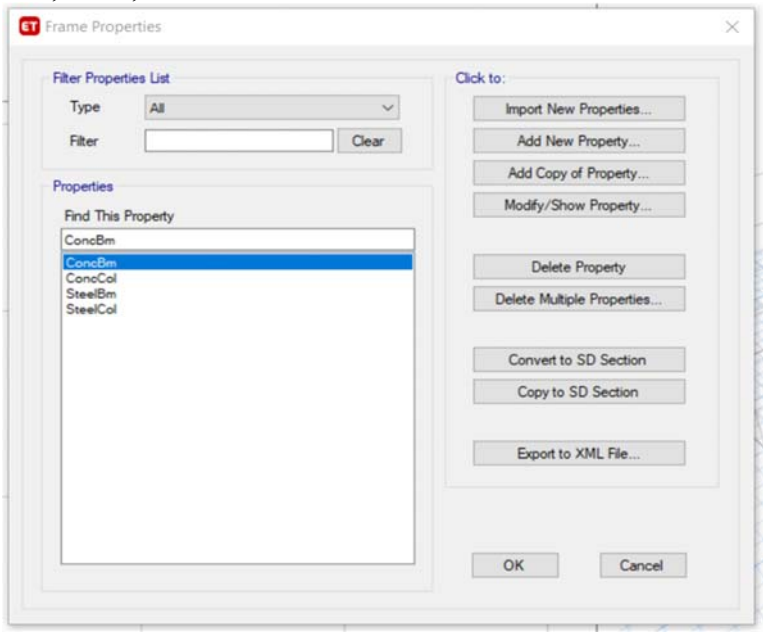
Define material property

- Concrete and rebar



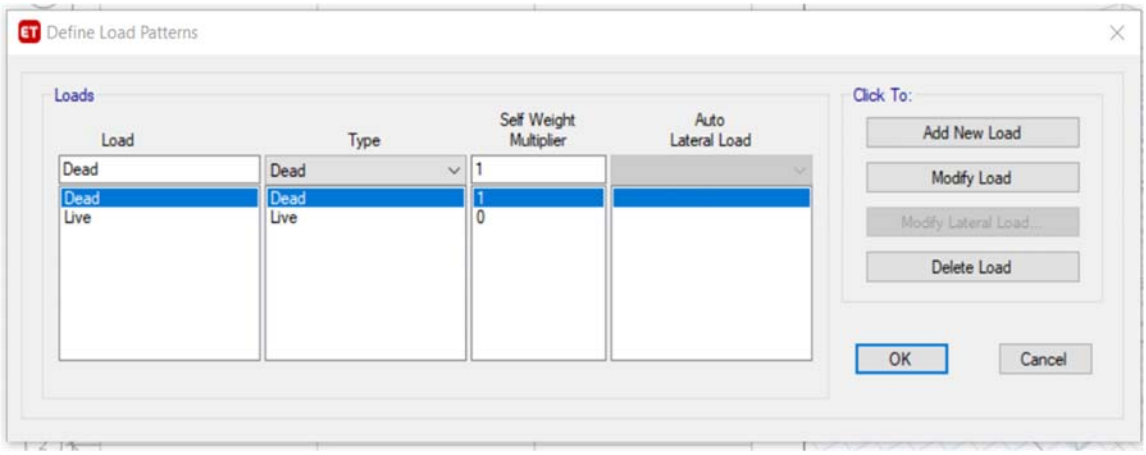
Define section properties

- Column, Beam, Slab, Walls

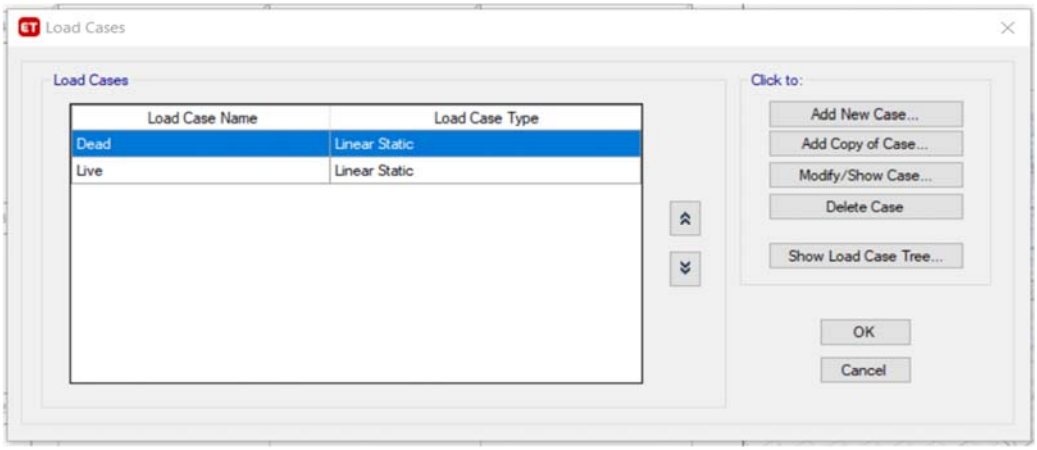


Define load pattern

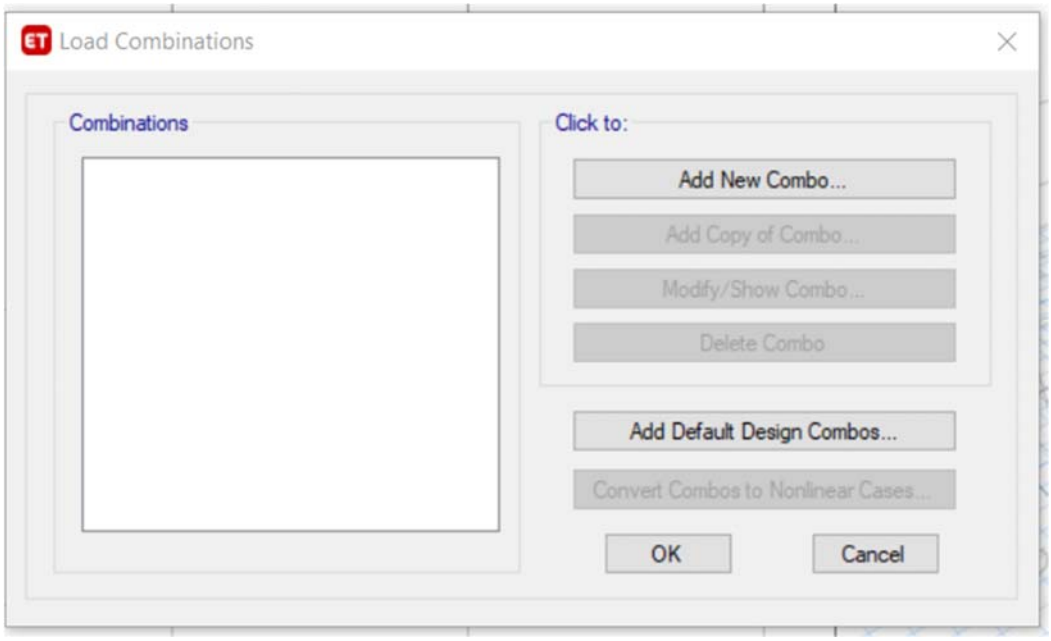
- DL, LL



Define load cases



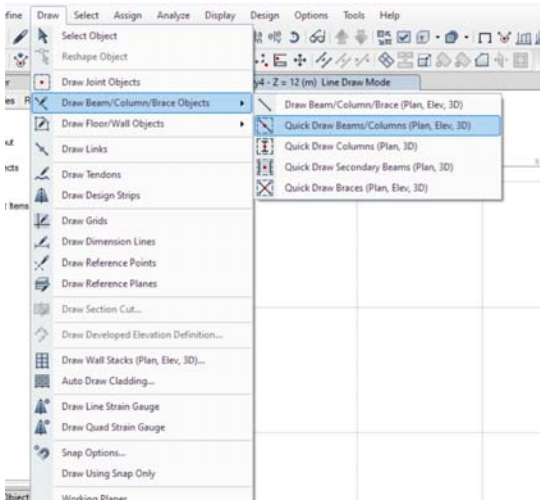
Define load combination



Model Simple Building

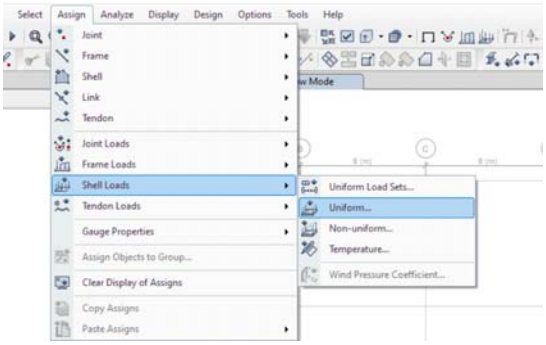
Draw

- Draw column and quick draw column
- Draw wall
- Draw slab
- Opening
- Draw beams



• Assign loads

- Slab loads
- Own weight
- Live
- Beams loads



• Mesh

- Shear wall and core (assign supports)
- Slab