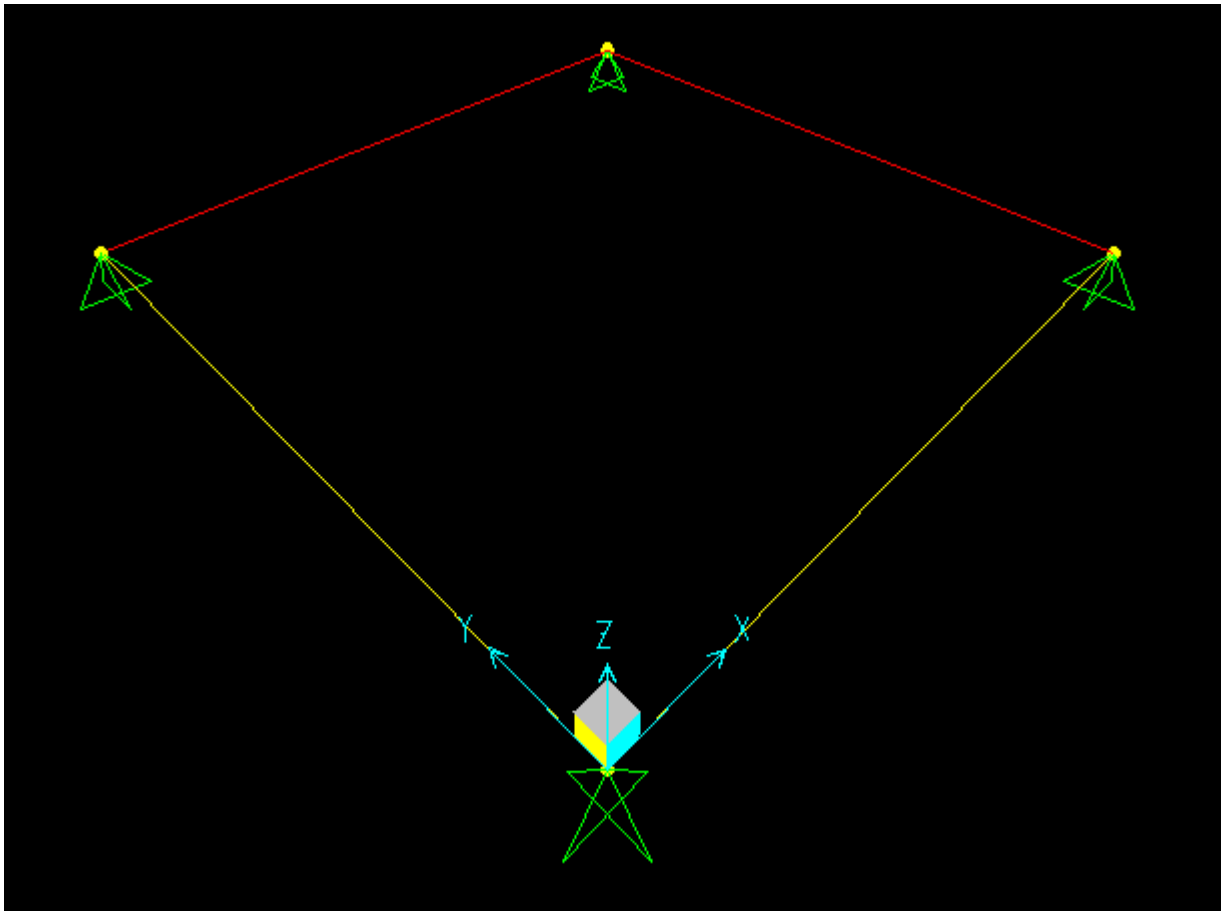
Options for Applying Area Loads

Introduction

This test problem illustrates various options for applying area loads using 3 different models described below:

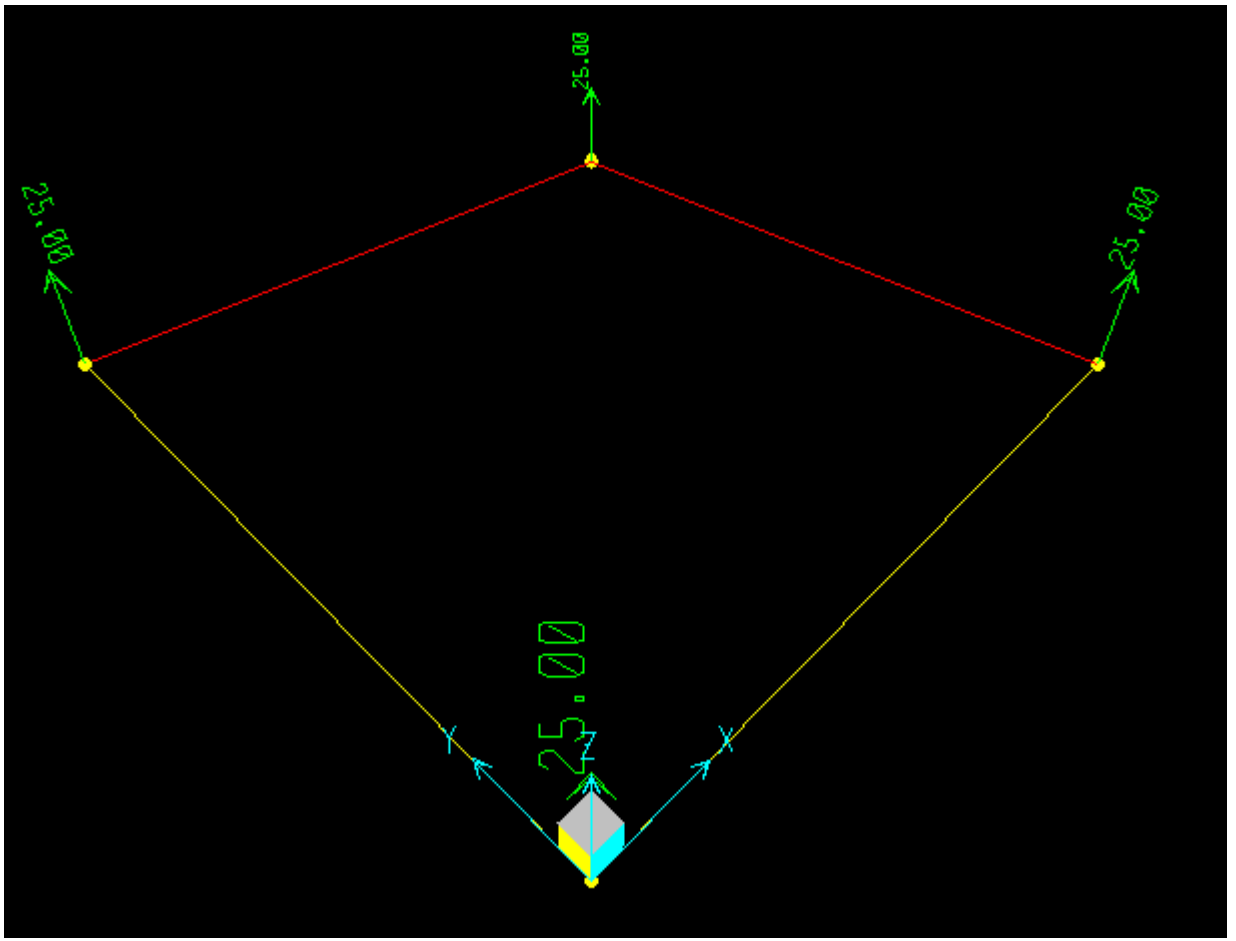
- Model A: Uniform (Shell); Uniform to Frame (Shell) – One Way; Uniform to Frame (Shell) – Two Way
- Model B: same as model A, but frames are divided to 10 segments
- Model C: same as model B, but shell is divided to 10 by 10 segments

Model A



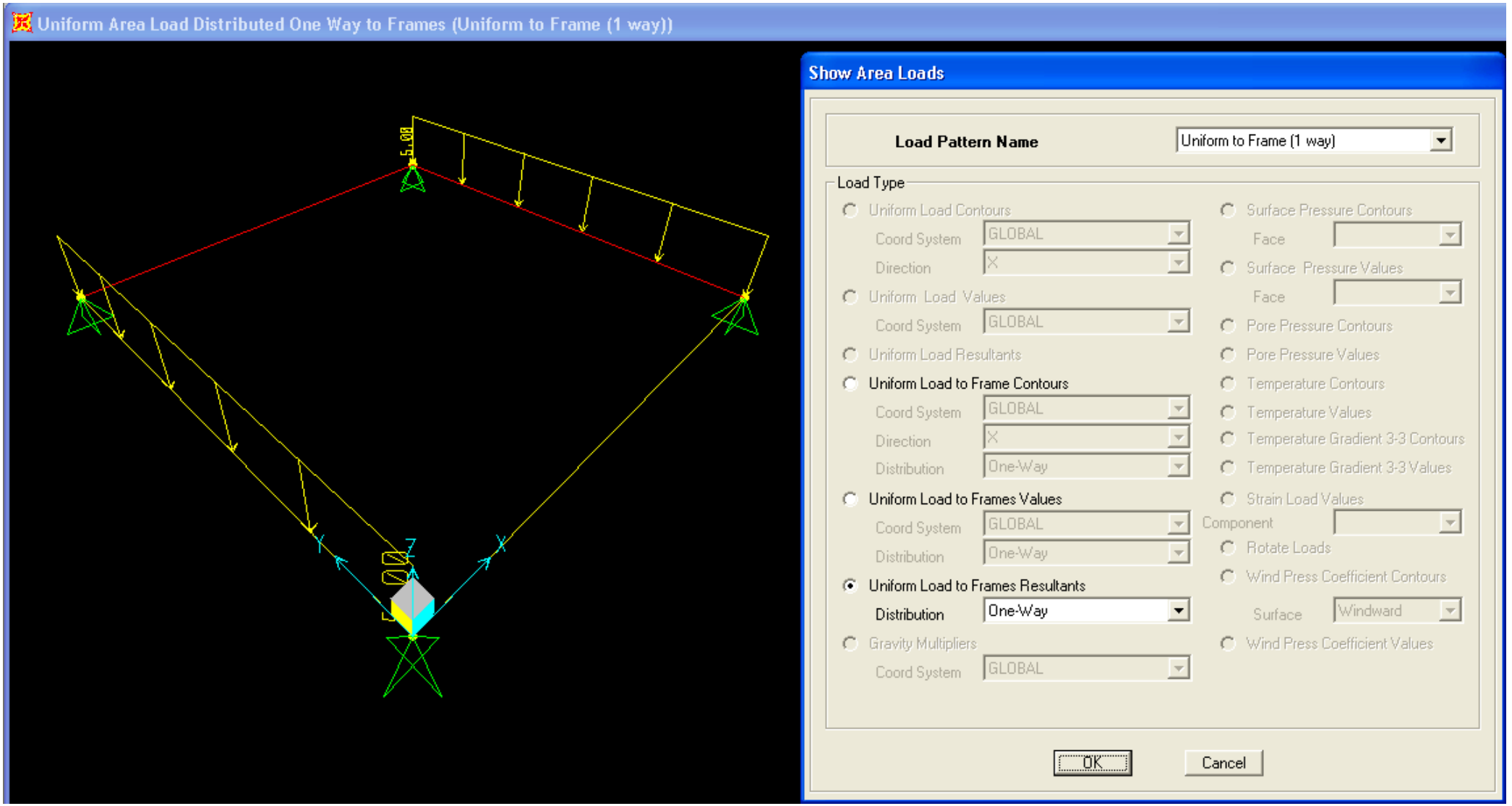
Model A contains 1 shell element and 4 frame elements on edges of the shell element and is simply supported at its 4 corners.

Uniform (Shell) Load

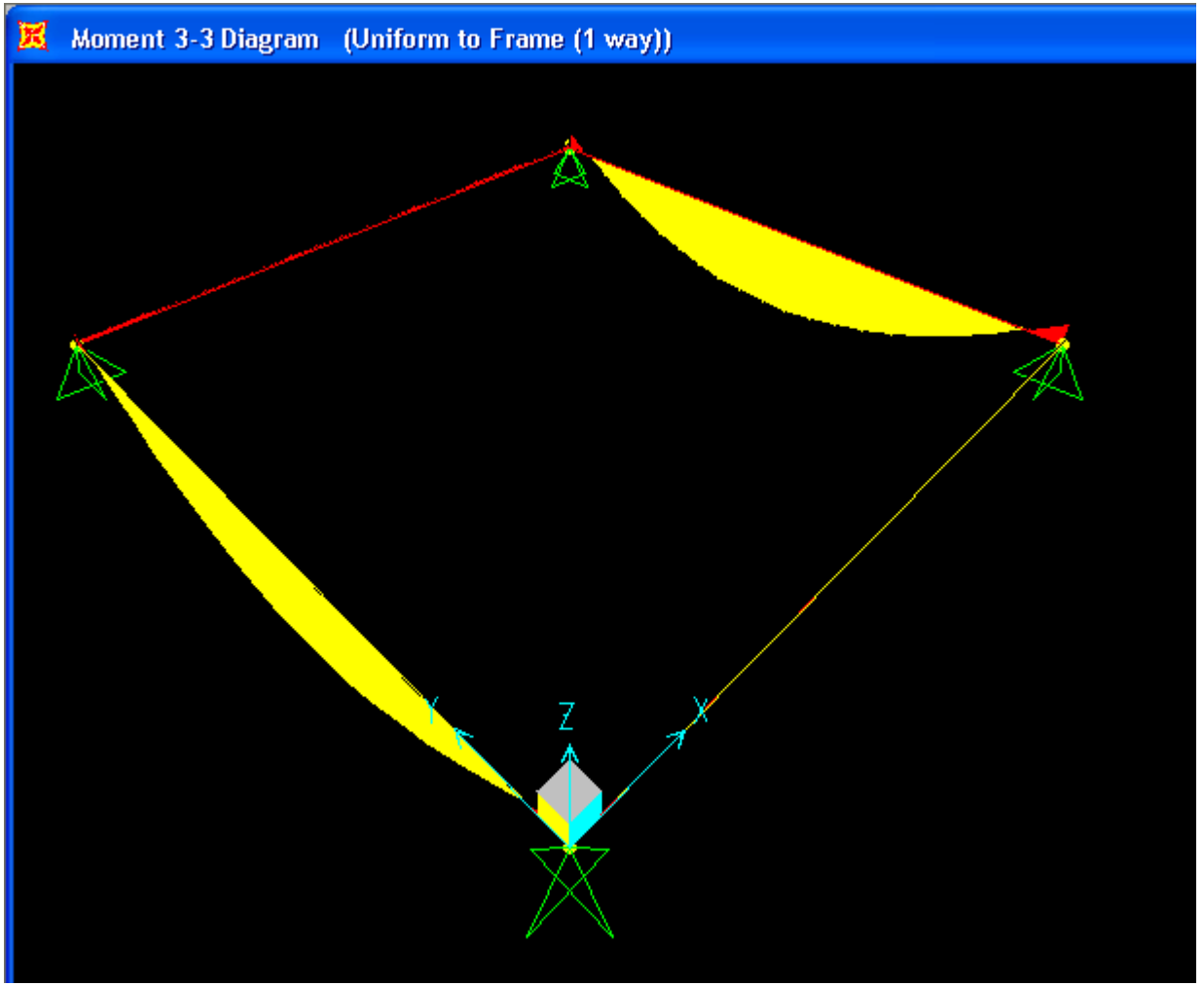


The load gets transferred directly applied to the 4 support joints and no internal forces in the shell or the frames are generated.

Uniform to Frame (Shell) – One Way

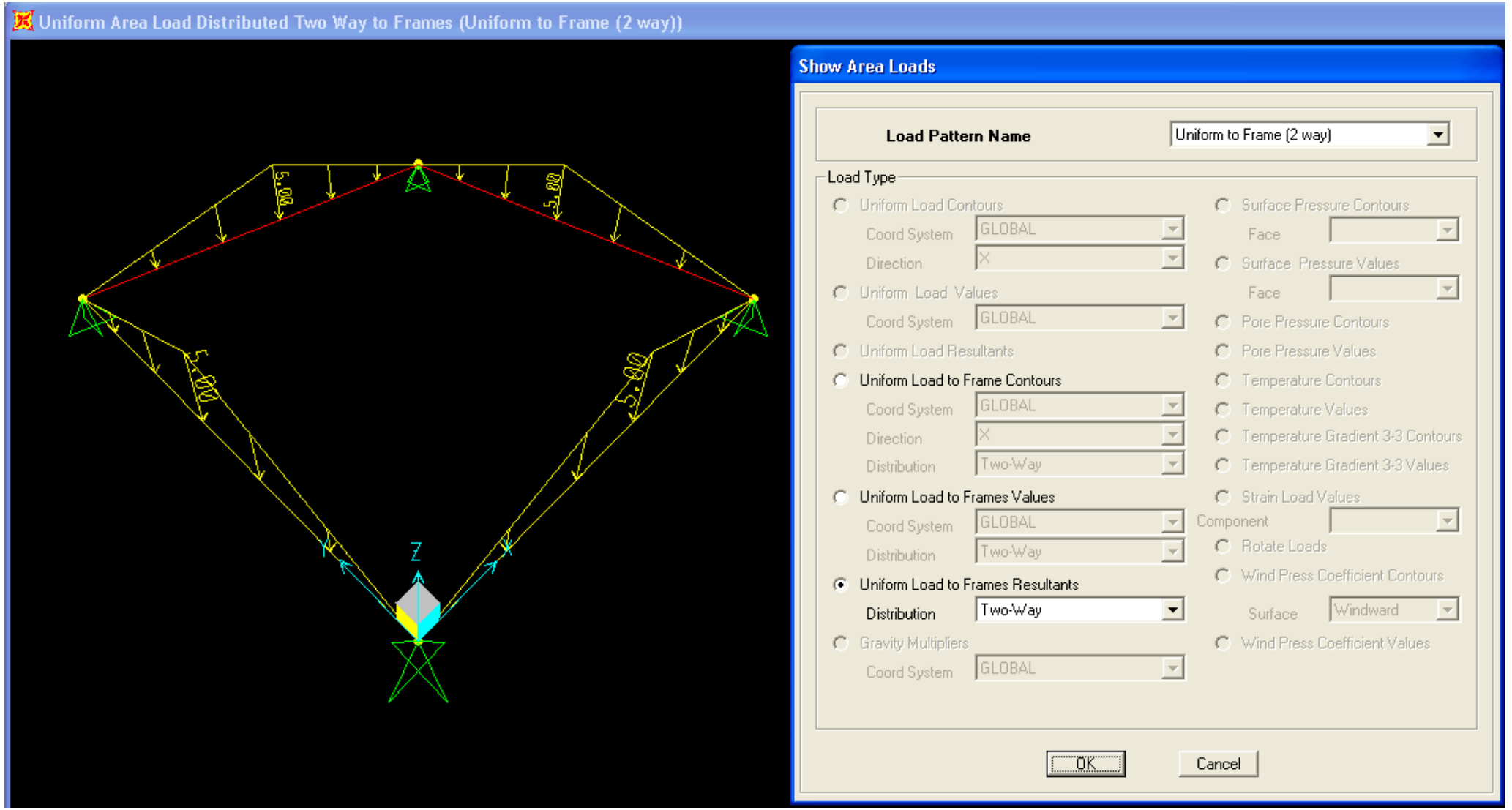


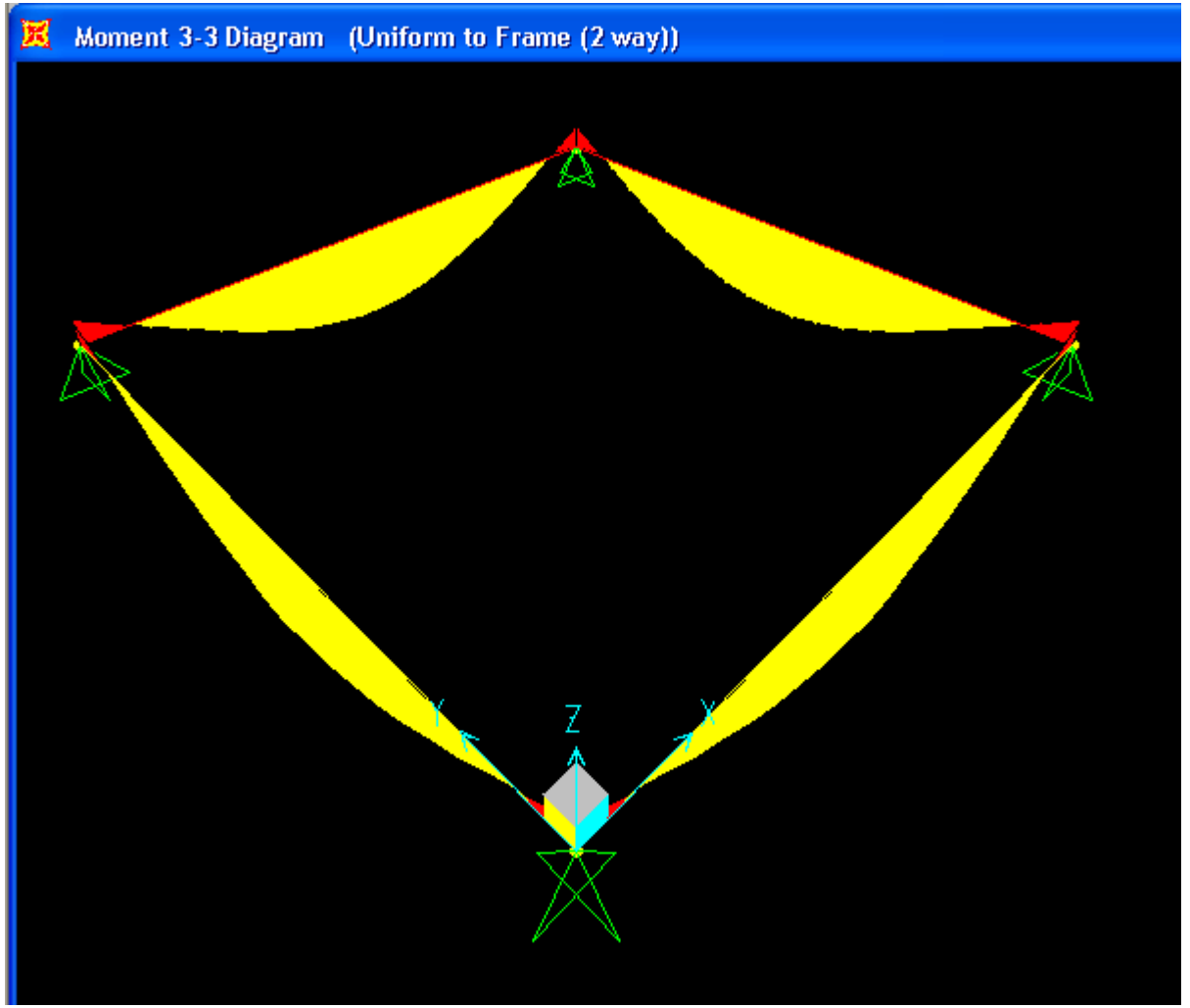
Use “Display > Show Load Assigns > Area” to display frame resultants.



Frame moments are consistent with the one-way load distribution.

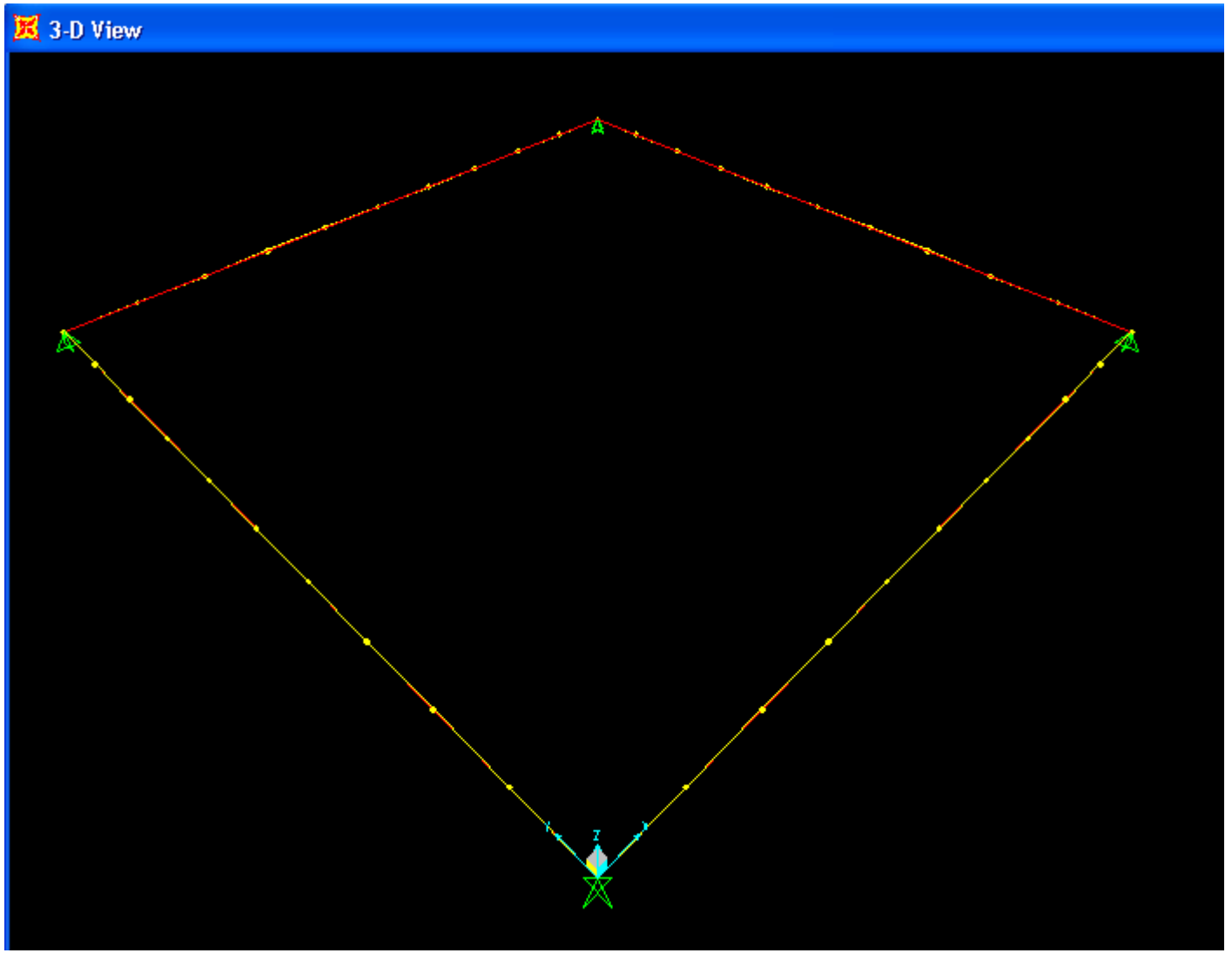
Uniform to Frame (Shell) – Two Way





Frame moment diagram is consistent with the two-way load distribution.

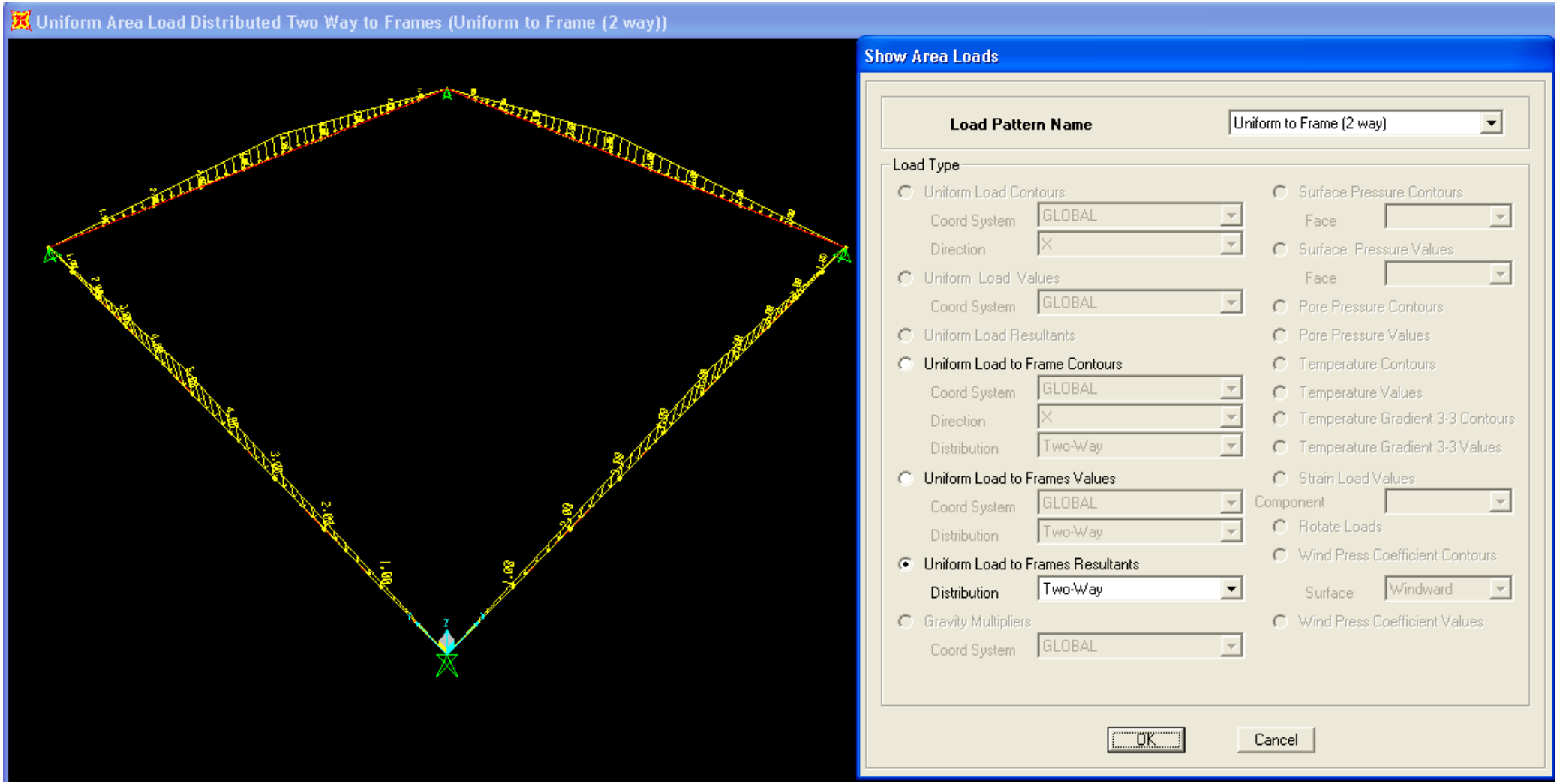
Model B

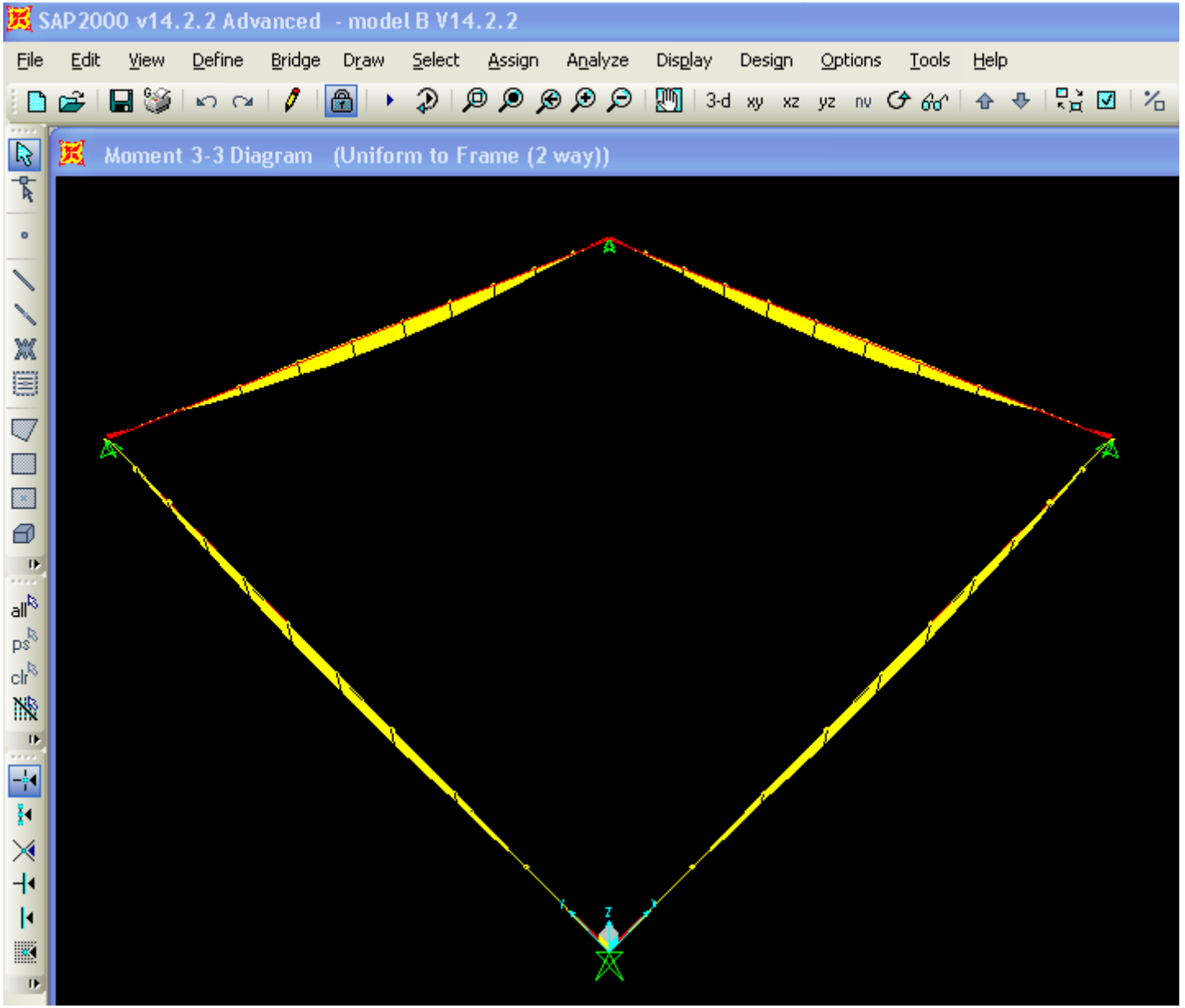


Model B contains 1 shell element and 40 frame elements (10 elements along each edge) and is supported at the 4 corner joints.

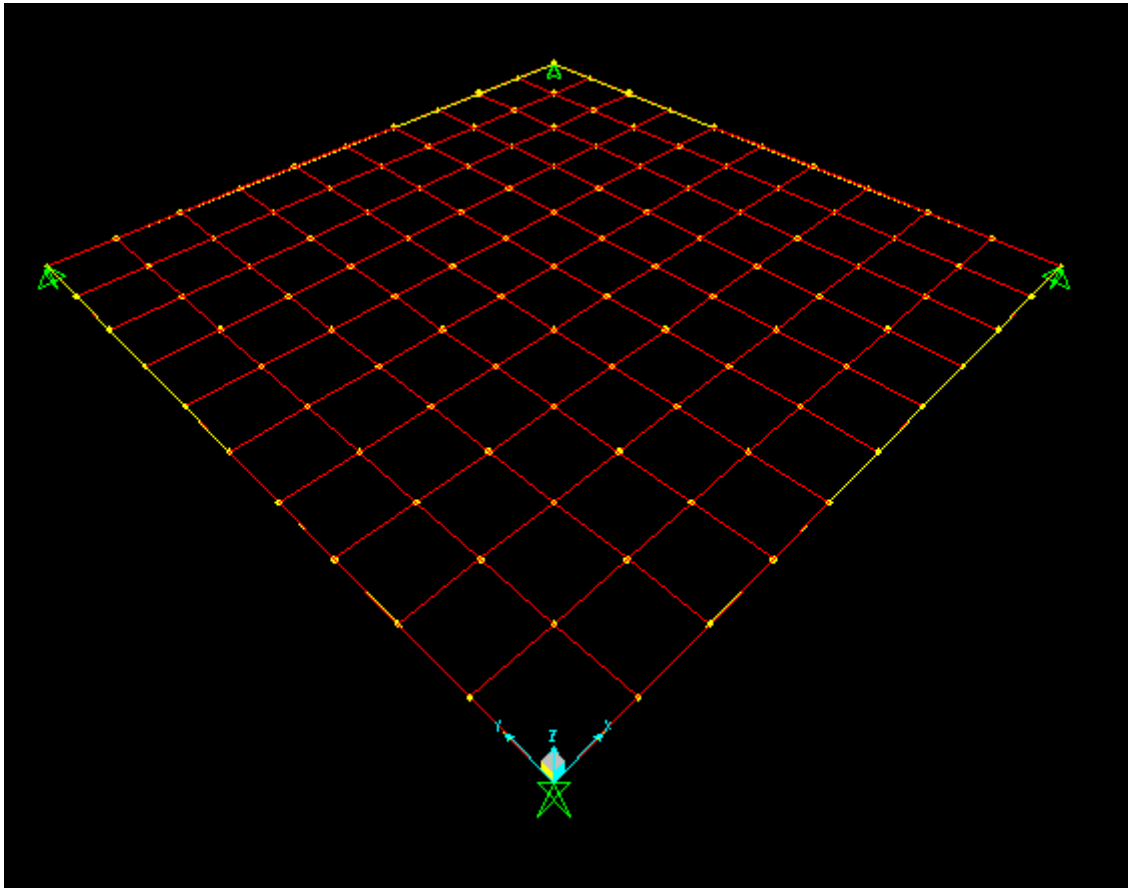
For this particular model, we will review only the “Uniform to Frame (Shell) – Two Way” load distribution.

Uniform to Frame (Shell) – Two Way




SAP2000 v14.2.2 Advanced - model B V14.2.2
File Edit View Define Bridge Draw Select Assign Analyze Display Design Options Tools Help
3-d xy xz yz nv
Moment 3-3 Diagram (Uniform to Frame (2 way))
all
ps
clr

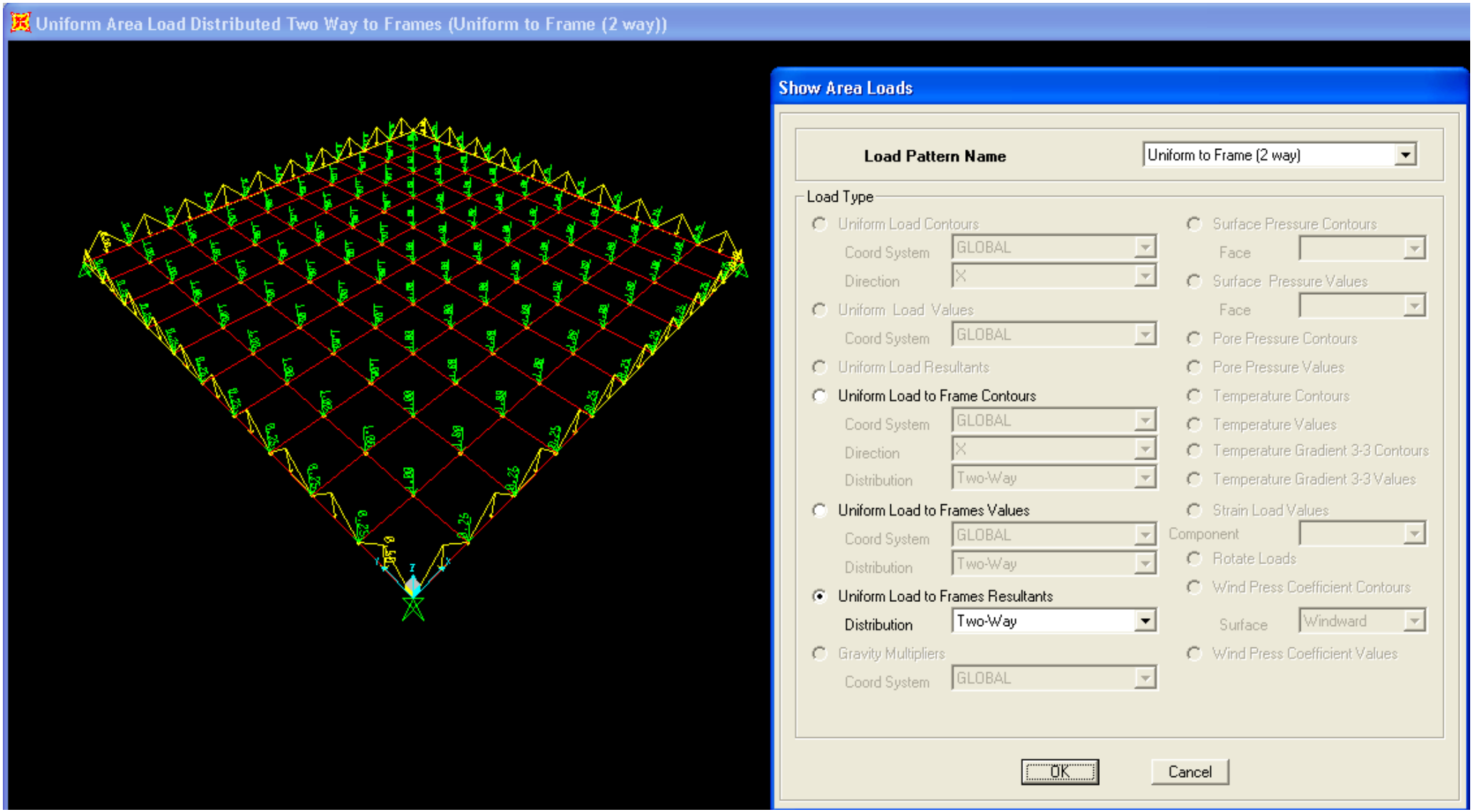
Model C



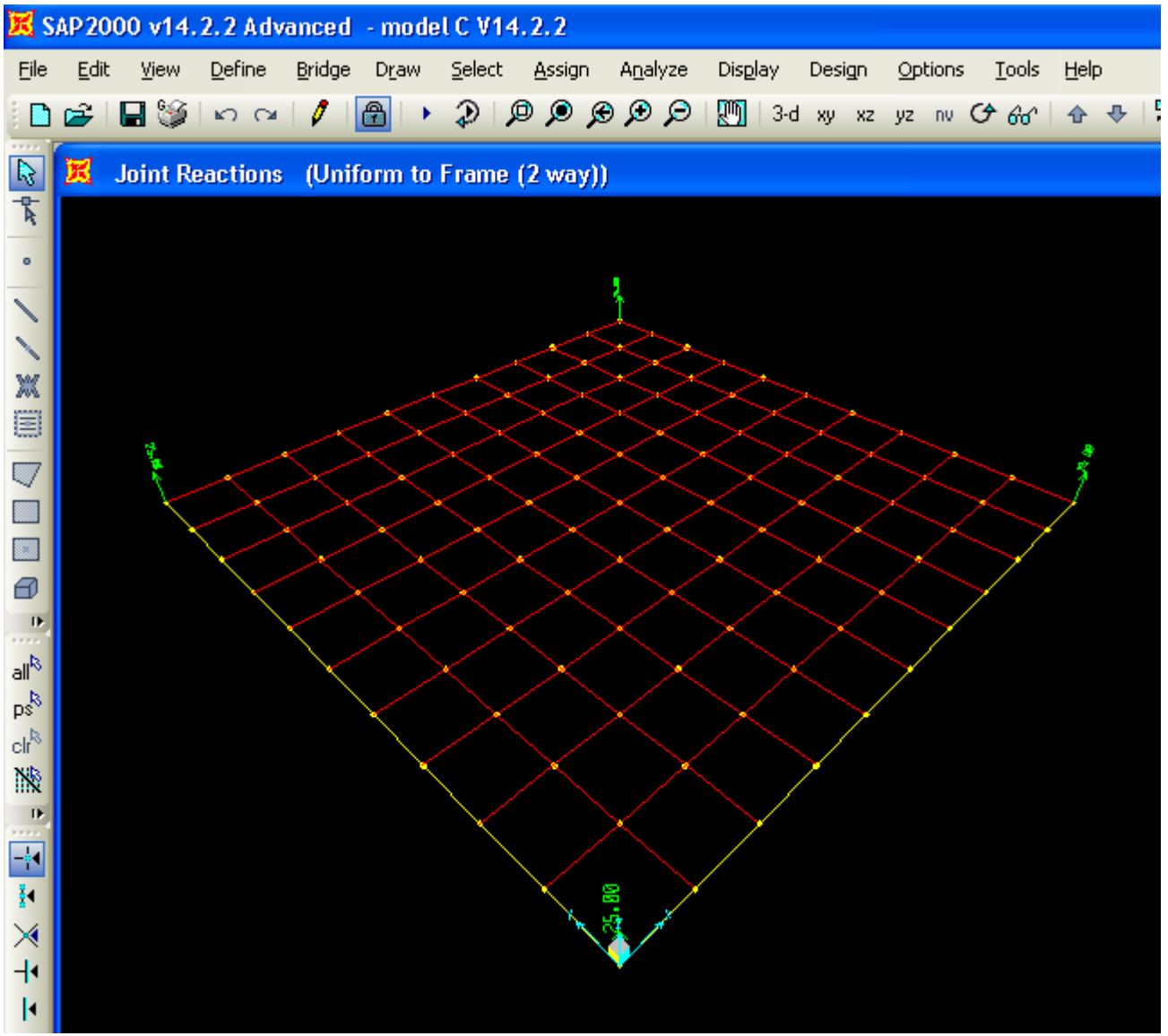
Model C has 100 shell elements (10 by 10) and 4 frame objects along the edges of the resulting slab. The model is simply supported at its four corners.

For this particular model, we will review only the “Uniform to Frame (Shell) – Two Way” load distribution.

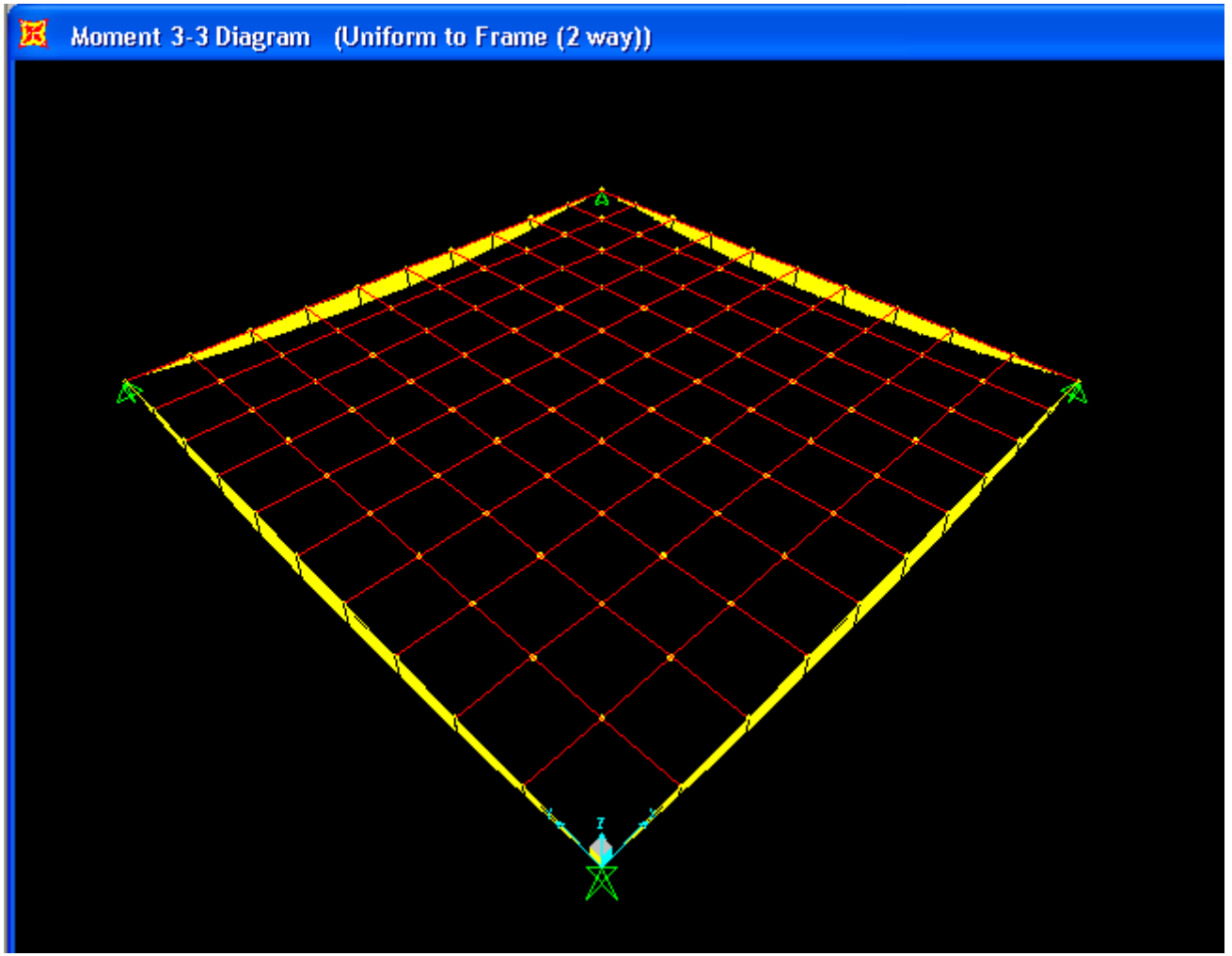
Uniform to Frame (Shell) – Two Way



Note that loads also get applied to internal joints so that no load gets lost.



Reaction of 25kN is obtained at each joint which is expected – no load is lost.


Moment 3-3 Diagram (Uniform to Frame (2 way))