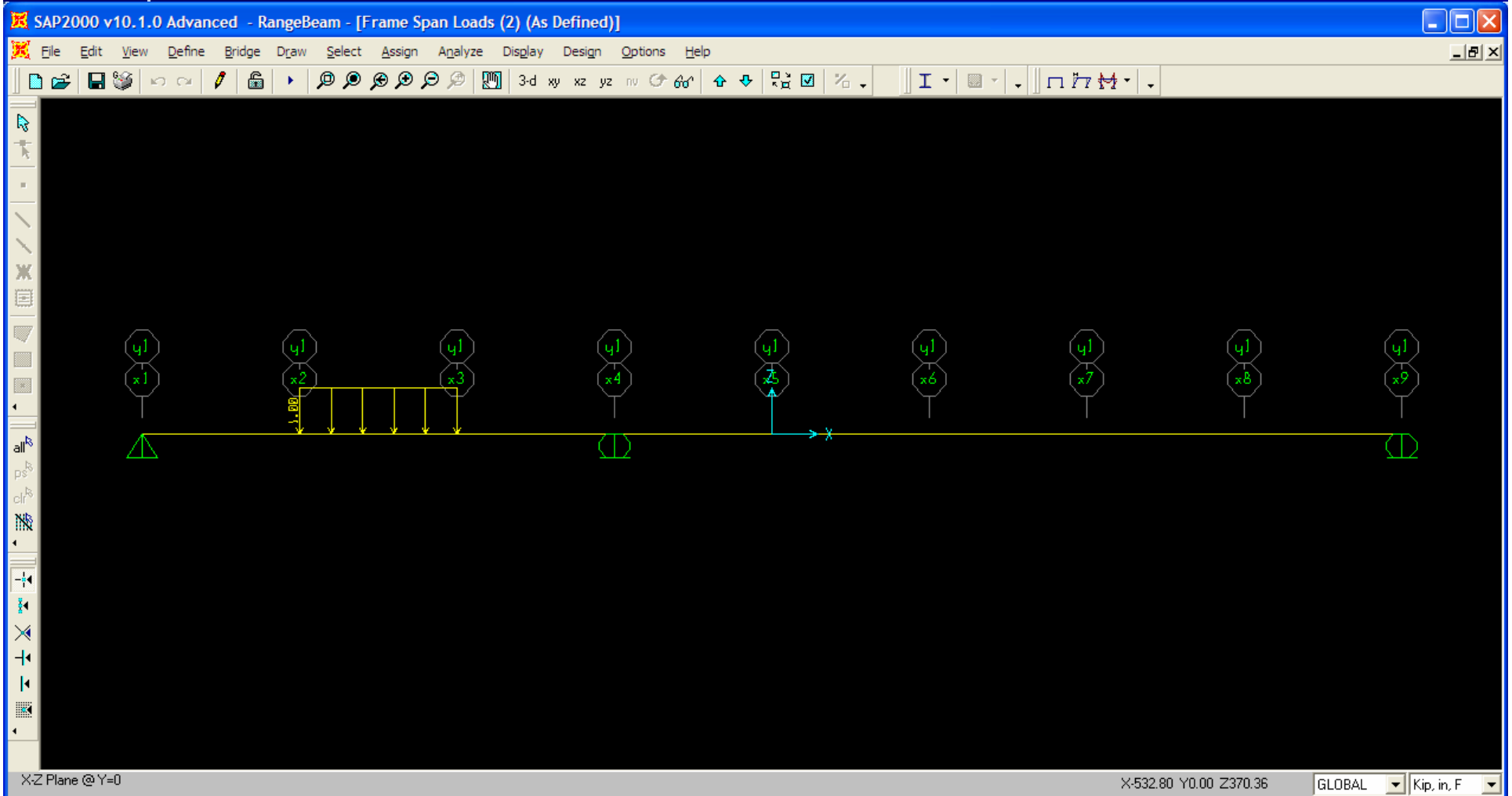


SAP2000 (and ETABS soon)

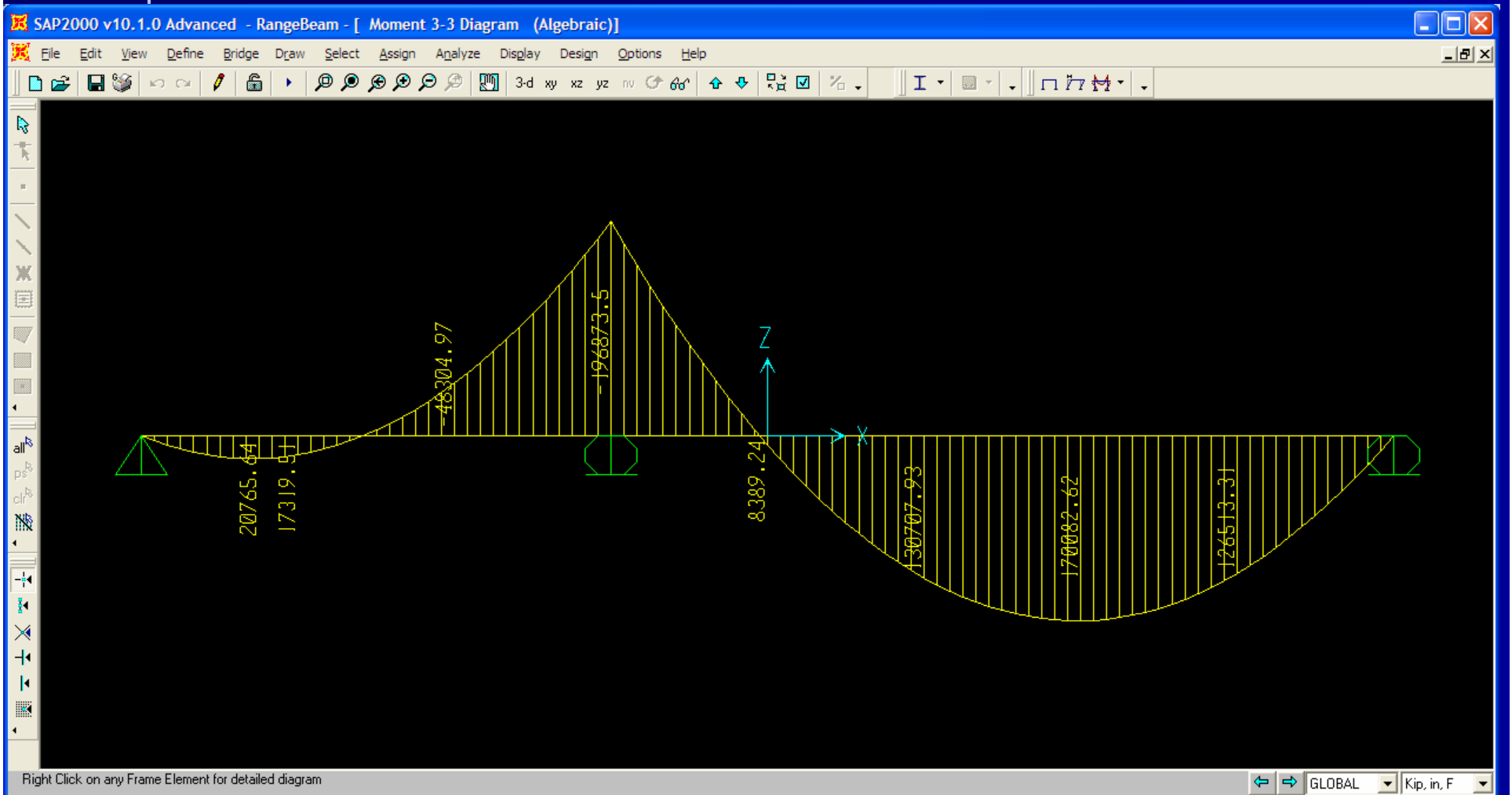
New "Range Add" Combo
(Enveloping Add)

For pattern loading, such as the most extreme response over all possible combinations of individually loaded bays in a multi-story building

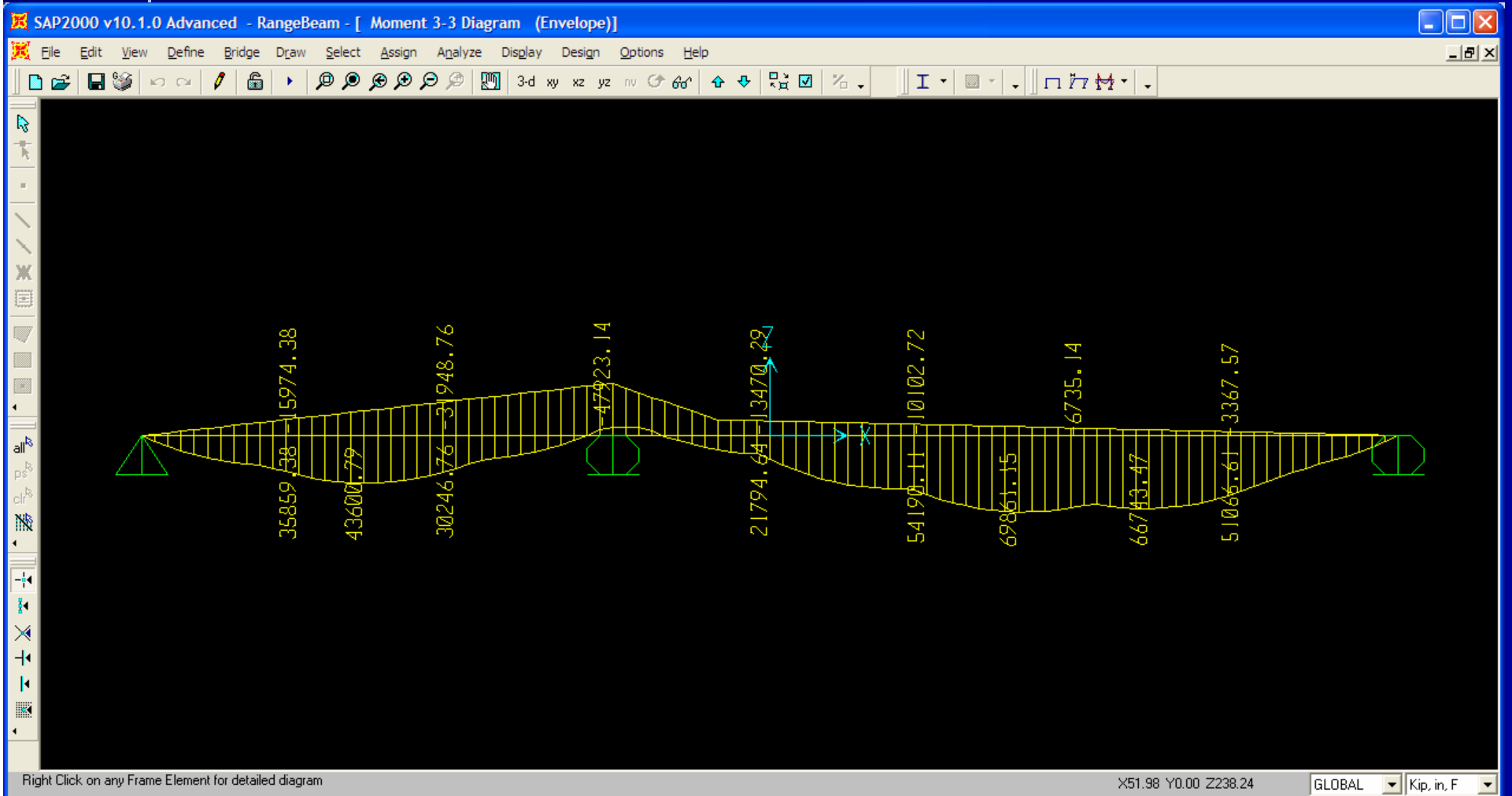
The beam below has 8 separate Load Cases, each of which loads a 1/8 length of the beam.
Load Case 2 is shown...



Moment diagram for an Algebraic-Add Combo. All 8 Load Cases are added together, equivalent to uniform load on the entire beam...



Moment diagram for an Enveloping Combo. All 8 Load Cases are considered independently, only one acting at a time. Max and Min are shown...



For pattern type-loading,
we want the envelope of:

- Any single load case (same as the envelope combo previously shown), 8 permutations
- Any pair of load cases, 28 permutations
- Any three load cases, 56 permutations
- Any four load cases, 70 permutations
- Any five load cases, 56 permutations
- Any six load cases, 28 permutations
- Any seven load cases, 8 permutations
- All eight cases (same as the additive combo previously shown), 1 permutation

For a total of 255 possible permutations!

In the past,

we would have had to define 255 additive combos, plus one more combo that envelopes them all.

Now we can define a single "Range Add" combo to get the same results:

- Simply list the 8 load cases as we would for adding or enveloping
- The computation starts with zero for Max and Min
- For each contributing case:
 - Positive values add to the Max
 - Negative values add to the Min
- If the contributing case is another combo:
 - Positive Max values add to the Max
 - Negative Min values add to the Min
- The result represents a range of results that always includes zero
- The specification is easy, the computation is quick

Moment diagram for a single Range Add Combo.
All 8 Load Cases are included. Equivalent to 255 additive and 1 enveloping combo...

