The 'rapid' method to draw shear and bending moment diagrams

Shear and bending moment diagrams are governed by these equations and must be consistent with them.

1. $$\frac{dV}{dx} = -w(x)$$
2. $$\Delta V = -\int_a^b w(x)dx$$
3. $$\frac{dM}{dx} = V(x)$$
4. $$\Delta M = \int_a^b V(x)dx$$

1. First, **determine the reaction forces** and moments by drawing a free body diagram of the entire beam and applying the equilibrium equations. Double check that your reactions are correct.
2. Establish the shear graph with a horizontal axis below the beam and a vertical axis to represent shear. Positive shears will be plotted above the x-axis and negative below.
3. Make vertical lines at all the "interesting points," i.e. points where concentrated forces or moments act on the beam and at the beginning and end of any distributed loads. This divides the beam into segments between vertical lines.
4. **Draw the shear diagram** by starting with a dot at $x = 0$, $V = 0$ then proceeding from left to right until you reach the end of the beam. Choose and label a scale which keeps the diagram a reasonable size.
   a. Whenever you encounter a concentrated force, jump up or down by that value.
   b. Whenever you encounter a concentrated moment, do not jump.
   c. Whenever you encounter a distributed load, move up or down by the 'area' under the loading curve over the length of the segment, according to equation two. The 'area' is actually a force.
   d. The slope of the curve at each point x is given by equation one. Distributed loads cause the shear diagram to have a slope equal to the negative value of the load at that point. For unloaded segments of the beam, the slope is zero, i.e. the shear curve is horizontal. For segments with uniformly distributed load, the slope is constant.
   e. The shear diagram should start and end at $V = 0$. If it doesn't, recheck your work.
5. Add another interesting point wherever the shear diagram crosses the x-axis, and determine the x position of the zero crossing.
6. After you have completed the shear diagram, **calculate the area under the shear curve** for each segment. Areas above the axis are positive, areas below the axis are negative. The areas represent moments and the sum of the areas plus the values of any concentrated moments should add to zero. If they don't, then recheck your work.
7. Establish the moment graph with a horizontal axis below the shear diagram and a vertical axis to represent moment. Positive moments will be plotted above the x-axis and negative below.
8. **Draw and label dots on the moment diagram** by starting with a dot at $x = 0$, $M = 0$ then proceed from left to right placing dots until you reach the end of the beam. As you move over each segment move up or down from the current value by the 'area' under the shear curve for that segment and place a dot on the graph. In this step, you are applying equation four.
   a. Positive areas cause the moment to increase, negative areas cause it to decrease.
   b. If you encounter a concentrated moment, jump straight up or down by the amount of the moment and place a dot. Clockwise moments cause upward jumps and counterclockwise moments cause downward jumps.
   c. When you reach the end of the beam you should return to $M = 0$. If you don't, then recheck your work.
9. **Connect the dots with the correct shaped lines.** Segments under constant shear are straight lines, segments under changing shear are curves. The general curvature of the lines can be determined by considering equation 3.