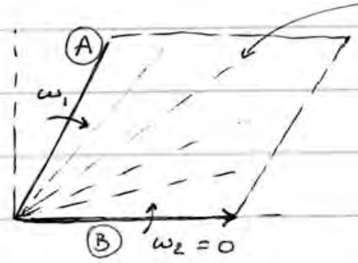
Muddy Points (11/17)

I didn't quite understand why you took the average of the angular velocities.

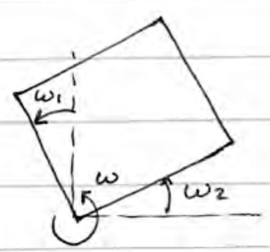
Take a look at the diagrams below. They might help you to see why we consider the average of the angular velocities. In the first case, side B is not rotating, but since side A does, the fluid inside the volume will rotate too, although at different rates. The actual rotation rate (angular velocity) will lie between the fastest (near A) and the lowest (near B) rotation rates. Taking the average in our infinitesimal element is quite accurate.
At the bottom of the page you can see two cases to illustrate this further. In the first one, there is a net counterclockwise rotation. In the second case, there is rotation only if the angular velocities of A and B are different in magnitude.



notice how the angular velocity <u>inside</u> the volume changes from side A to side B.

- Faster on A
- Zero on B

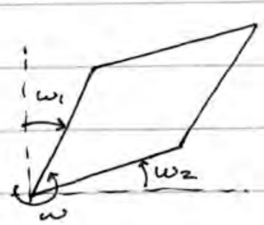
The net element rotation rate is defined as the average between the angular velocities of A & B



net rotation $\omega = \frac{1}{2}(\omega_1 + \omega_2)$

in particular, if $\omega_1 = \omega_2$

$\omega = \frac{1}{2}(2\omega_1) = \omega_1$



net rotation $\omega = \frac{1}{2}(\omega_1 + \omega_2)$

in particular, if $\omega_1 = -\omega_2$

$\omega = \frac{1}{2}(\omega_1 - \omega_1) = 0$

NO ROTATION