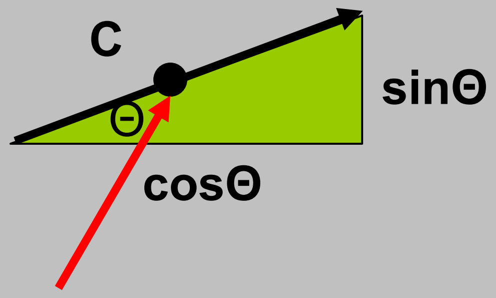
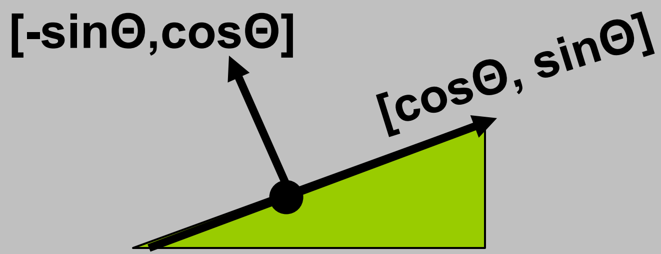
Because each linear ripple has an angle Θ, we can think of its direction and perpendicular normal like this:

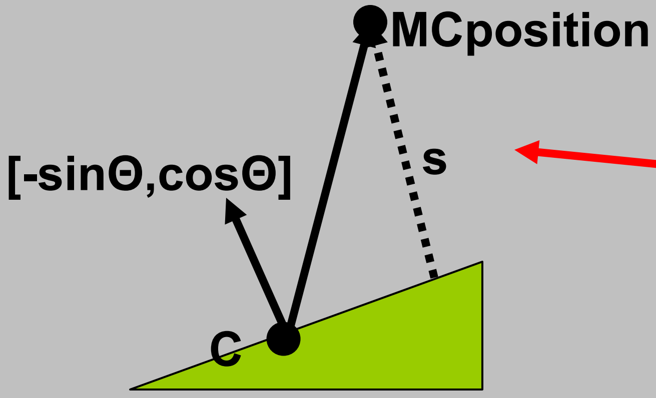


The linear ripple goes through the point C in the direction [cosΘ, sinΘ]



The normal is then [-sinΘ, cosΘ]

(Note that slope · normal = 0, as it must be.)



The distance, s, of a Model Coordinate position perpendicular to the linear ripple is:

s = (MCposition-C) · (sinΘ, cosΘ)

The amplitude of the wave, z, is:

$$z = - \mathrm{Amp} * \cos(2\pi s/P - 2\pi \mathrm{Time})$$

(where P is the wave period)

And the slope dz/ds is:

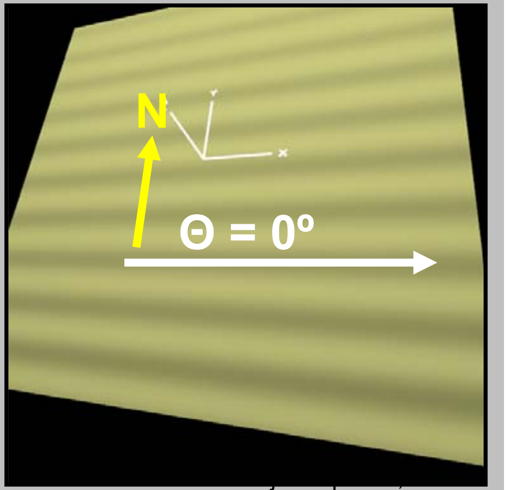
$$dz/ds = \mathrm{Amp} * 2\pi/P \ * \sin(2\pi s/P - 2\pi \mathrm{Time})$$

If we start by assuming that the ripple angle is 0º (i.e., the wave is propagating in y), then the vector slope of the wave is:

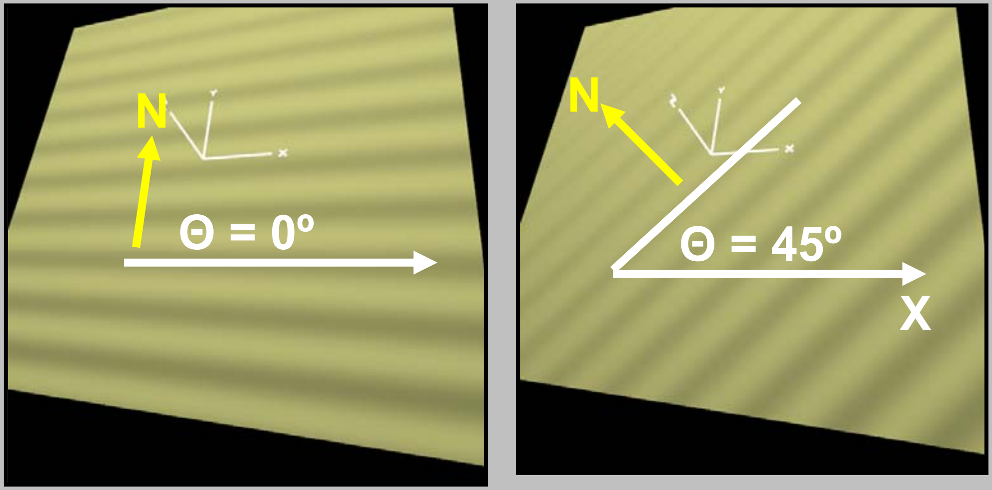
$$\begin{aligned} \mathrm{slope} &= [\ 0.,\ 1.,\ dz/dy] \\ &= [\ 0.,\ 1.,\ \mathrm{Amp} * 2\pi/P \ * \sin(2\pi s/P - 2\pi \mathrm{Time})\ ] \end{aligned}$$

So the wave's vector normal while propagating in y is:

$$\mathrm{normal} = [\ 0.,\ -\mathrm{Amp} * 2\pi/P \ * \sin(2\pi s/P - 2\pi \mathrm{Time}),\ 1.\ ]$$



This is true if the wave is propagating in y, i.e., the ripple angle is 0º. The trick now is to rotate the normal vector into where we really are. Because we are just talking about a rotation, the transformation is the same as if we were rotating a vertex.



$$Nx' = Nx * \cos\Theta \; - \; Ny * \sin\Theta$$

$$Ny' = Nx * \sin\Theta \; + \; Ny * \cos\Theta$$

$$Nz' = Nz$$

```
vec3 normal = normalize(  vec3(Nx',Ny',Nz')  );
```

So, for any MCposition of a fragment, we compute the normal vector to the simulated rippled surface. We then make this interact with the light source location to make variations in intensity give the rippled appearance.