AugerBot Calculations

```
Quit
```

Trial 1: 9/19 - 9/26

Modified Francisco Calculations : 10/18

Plotting Fx to find U which Balances Forces: 11/1

```
Quit;
```

Parameters

For Helix

```
(*Current param: R = 1.8cm, ϕ = 5.4763645 deg, n = 3.5*)
R = 0.018; (*Screw radius, m*)
n = 3.5; (*Number of helix turns*)
```

For Material

```
zlpPoppy = 0.05; zcpPoppy = 0.5 / 6; zlpGlass = 0.05; zcpGlass = 0.1; (*N/cm^3*)
xlpPoppy = 0.0875; xcpPoppy = 0.125;
xlpGlass = 0.1 * (7 / 8); xcpGlass = 0.125; (*N/cm^3*)

(*For screw with ϕ = 5.4763645 deg*)
αz = zlpGlass * (100^3); (*Vertical stress per unit depth, N/m^3*)
αx = xlpGlass * (100^3); (*Horizontal stress per unit depth, N/m^3*)

d = 0.05;(*Depth robot buried, m*)

(*Friction coefficients*)
Cn = αz * d; (*N/m^2*)
Ct = αx * d;
```

For Motor

```
w = 2 * 1000 * (2 * Pi) / 3584; (*Angular velocity with 12V source, rad/s*)
```

- (2 ticks/ms)*(1000 ms/s)*(2*Pi rad/rev)*(1 rev/3584 ticks)

Thrust Equation

- one = 2*Pi*n/Cos[ϕ];
  two = (Cn - Ct)*w*Sin[ϕ]*Cos[ϕ];
  three = (R/(2*w^2))*Sqrt[(R*w)^2 + U^2];
  four = (U^2/(2*w^3))*(Log[U] - Log[R*w + Sqrt[(R*w)^2 + U^2]]);
  five = U*(Ct*Sin[ϕ]^2 + Cn*Cos[ϕ]^2)*(Sqrt[(R*w)^2 + U^2] - U)/w^2;
  Fx = one*(two*(three + four) - five);

```
Thrust[U_] := (2 * Pi * n / Cos[ϕ]) *
    (((Cn - Ct) * w * Sin[ϕ] * Cos[ϕ]) * (((R / (2 * w^2)) * Sqrt[(R * w) ^2 + U^2]) +
          ((U^2 / (2 * w^3)) * (Log[U] - Log[R * w + Sqrt[(R * w) ^2 + U^2]])))) -
      (U * (Ct * Sin[ϕ] ^2 + Cn * Cos[ϕ] ^2) * (Sqrt[(R * w) ^2 + U^2] - U) / w^2));
```

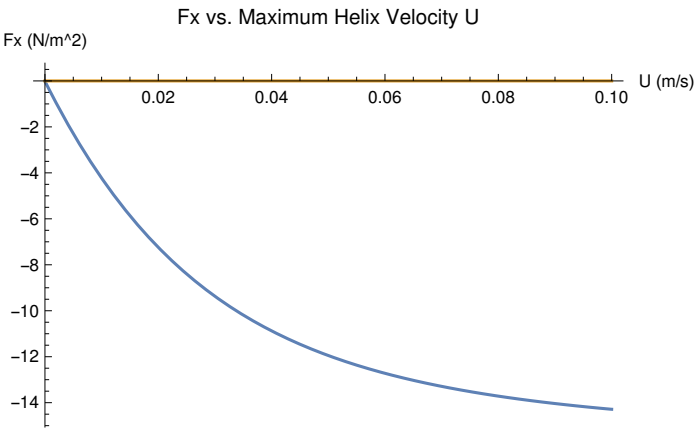
Plotting Thrust as a Function of U

```
ϕ = 5 * Pi / 180 // N (*Pitch angle, radians*)
```

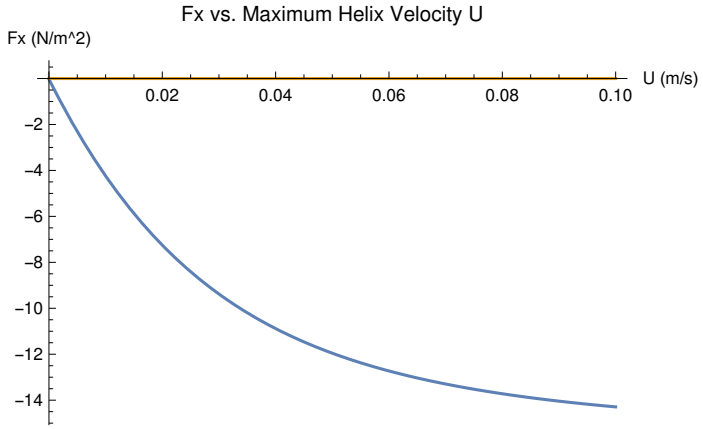
```
0.0872665
```

```
While[ϕ < 5 * Pi / 180,
 Print["Let ϕ = ", ϕ];
 Print@
  Plot[{Thrust[U], 0}, {U, 0, 0.1}, PlotLabel → "Fx vs. Maximum Helix Velocity U",
   AxesLabel → {"U (m/s)", "Fx (N/m^2)"}, PlotRange → All];
 ϕ = ϕ + (0.1 * Pi / 180);
]
```

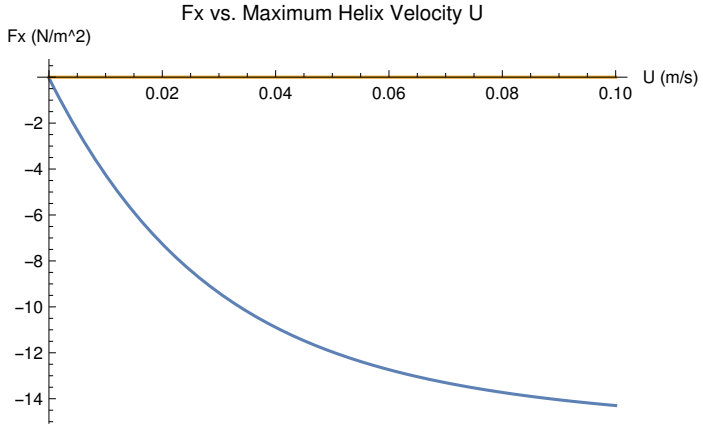
```
Let ϕ = 0.00174533
```



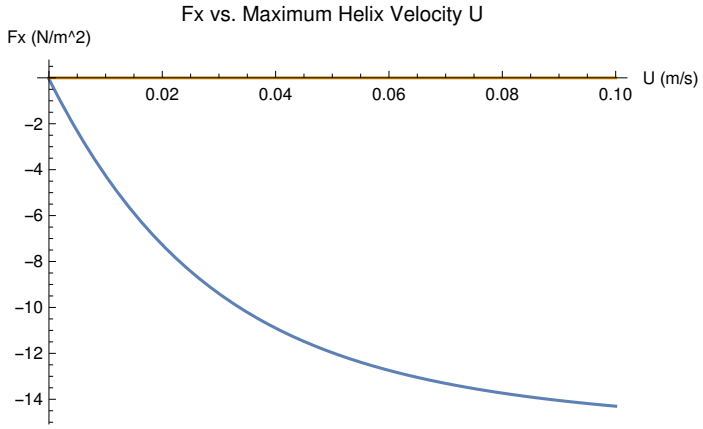

```
Let ϕ = 0.00349066
```



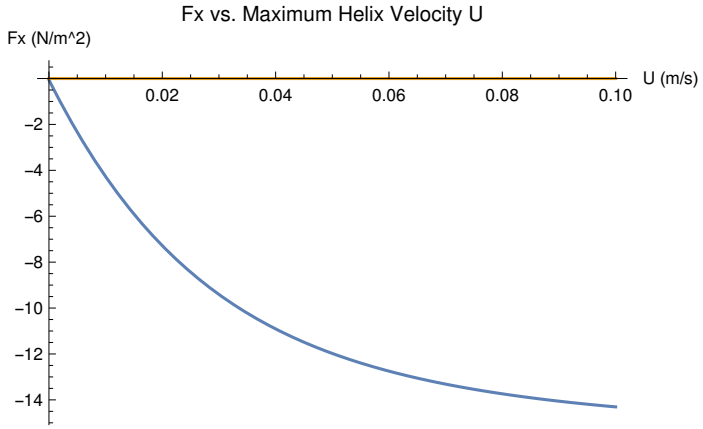
Let ϕ = 0.00523599



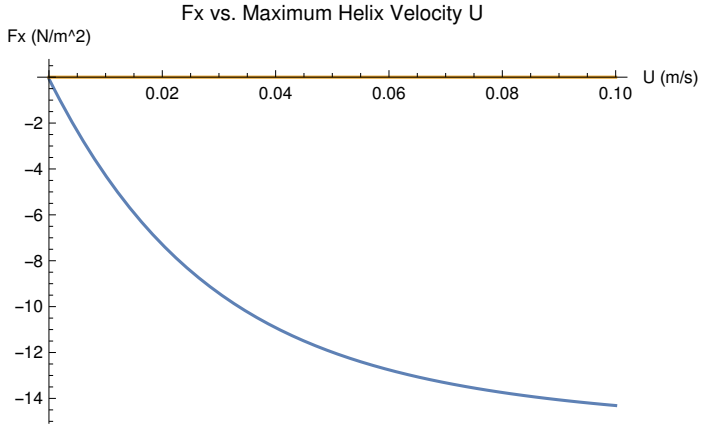
Let ϕ = 0.00698132



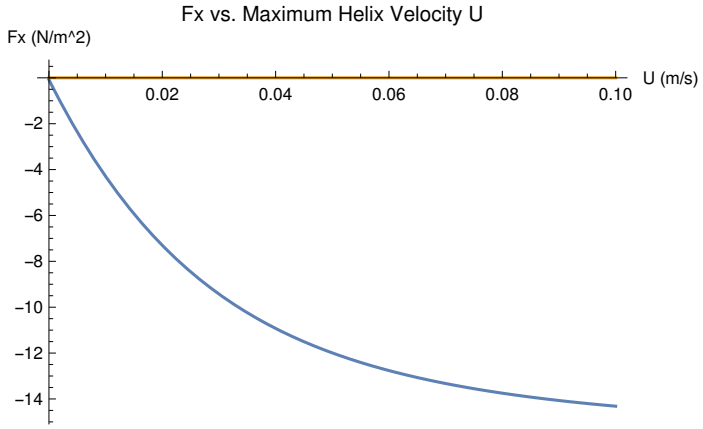
Let ϕ = 0.00872665



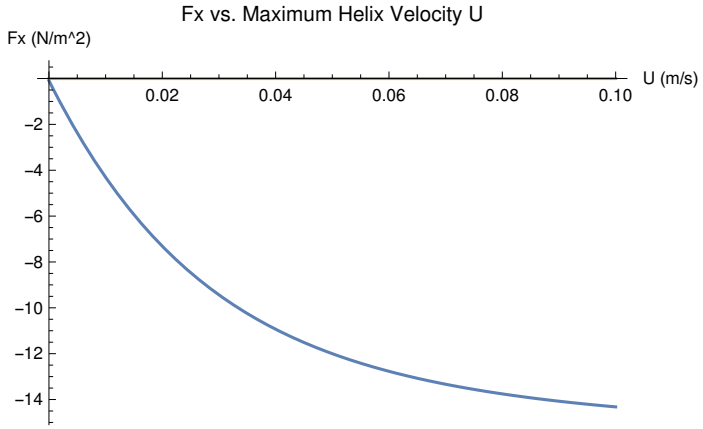
Let ϕ = 0.010472



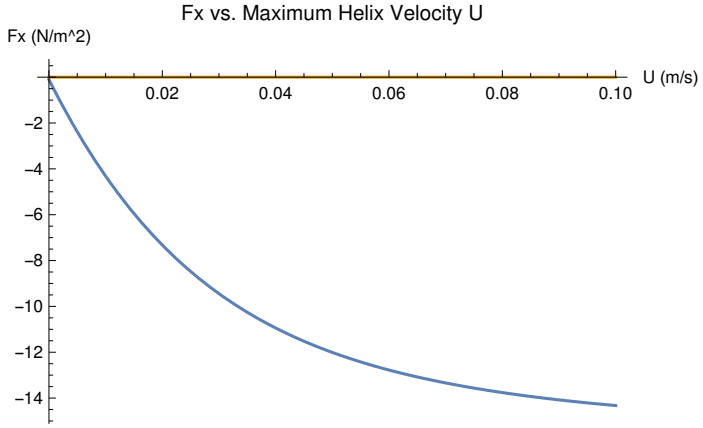
Let ϕ = 0.0122173



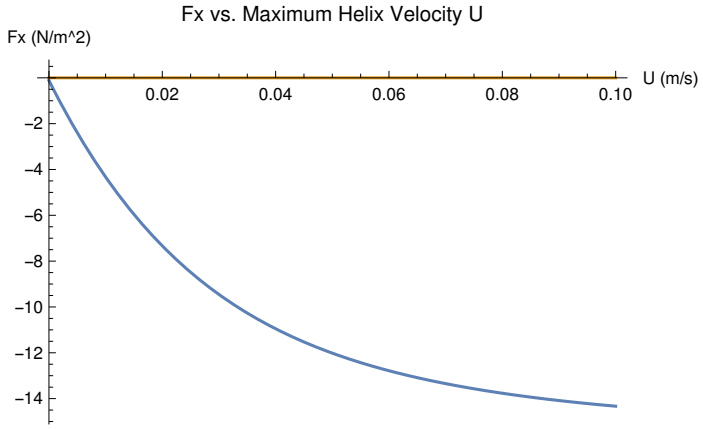
Let ϕ = 0.0139626



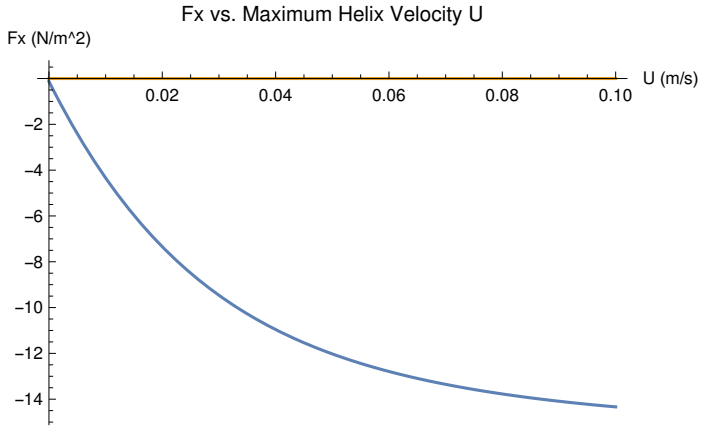
Let ϕ = 0.015708



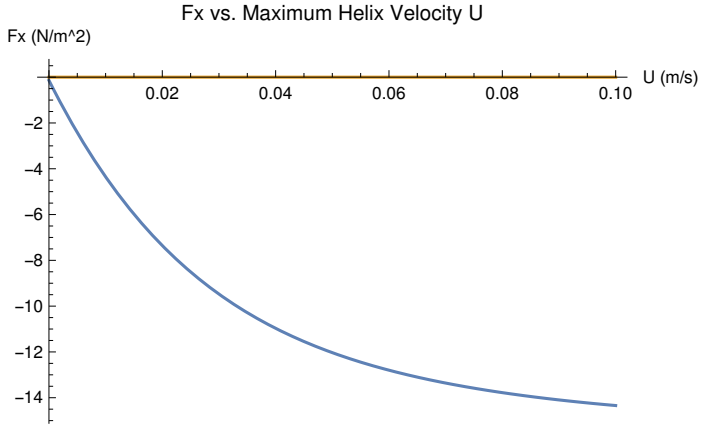
Let ϕ = 0.0174533



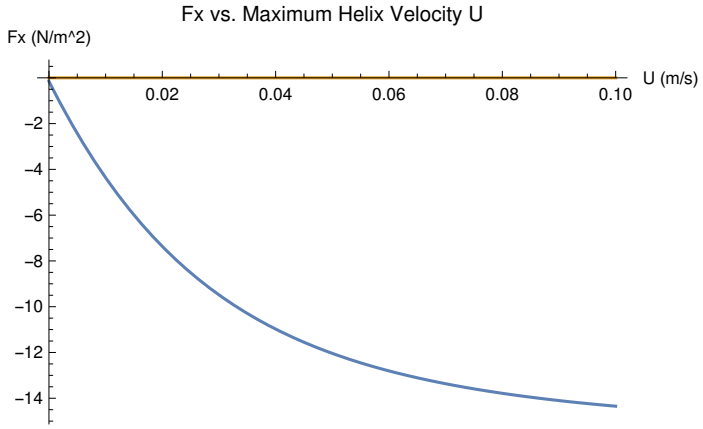
Let ϕ = 0.0191986



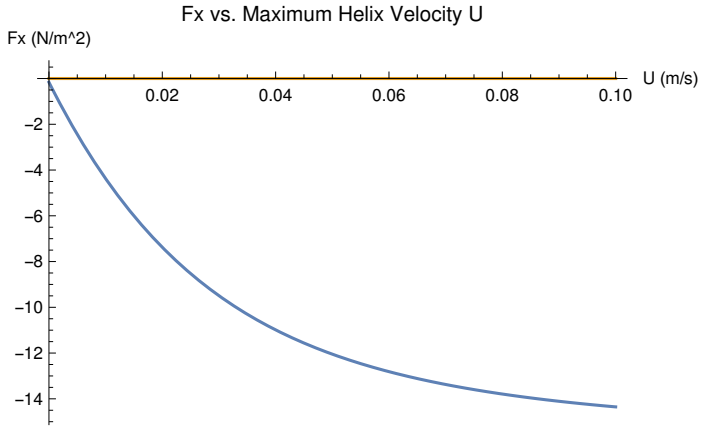
Let ϕ = 0.020944



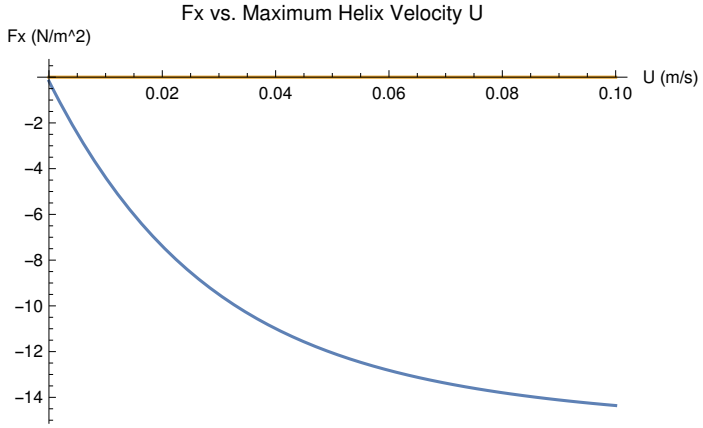
Let ϕ = 0.0226893



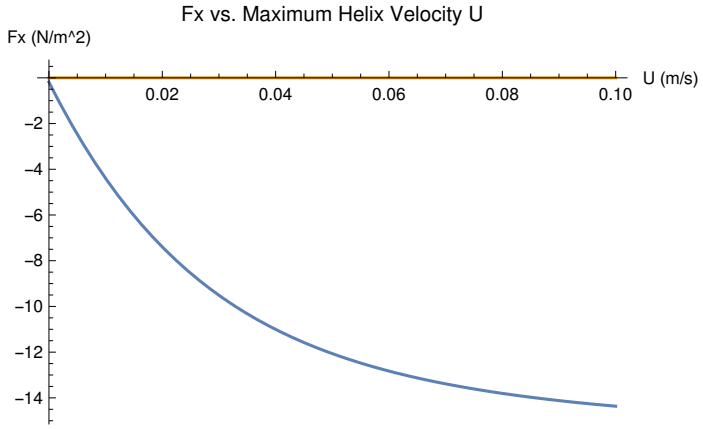
Let ϕ = 0.0244346



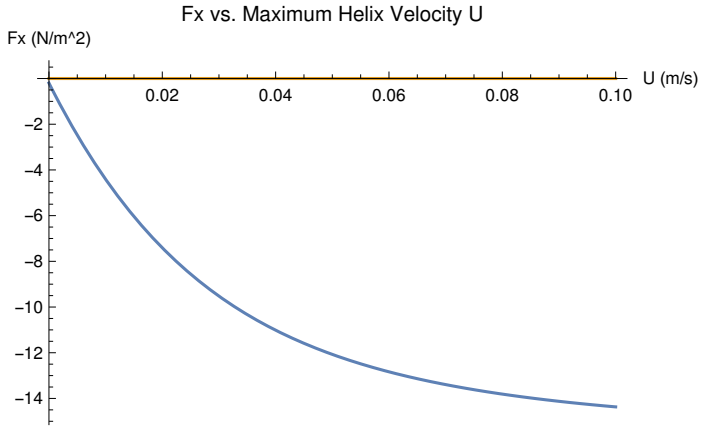
Let ϕ = 0.0261799



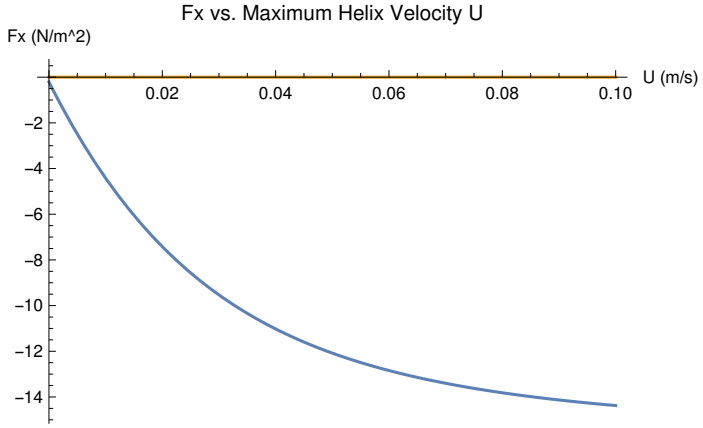
Let ϕ = 0.0279253



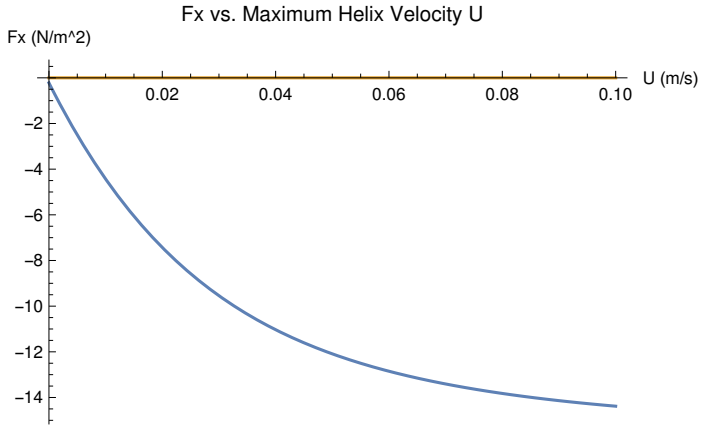
Let ϕ = 0.0296706



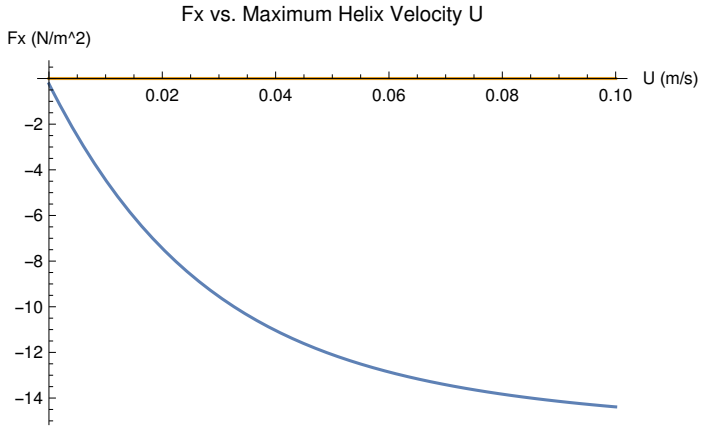
Let ϕ = 0.0314159



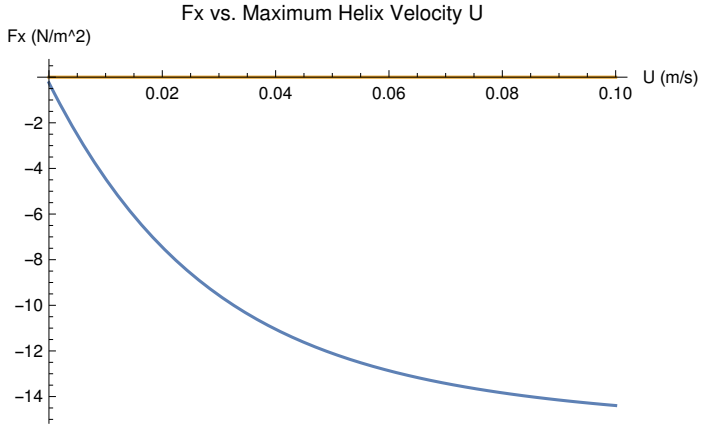
Let ϕ = 0.0331613



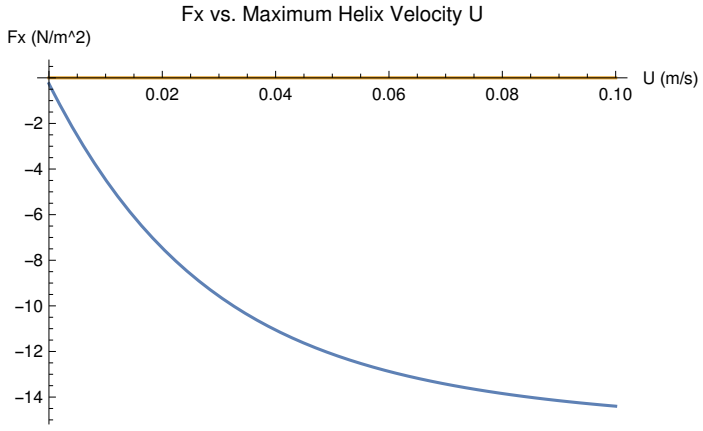
Let ϕ = 0.0349066



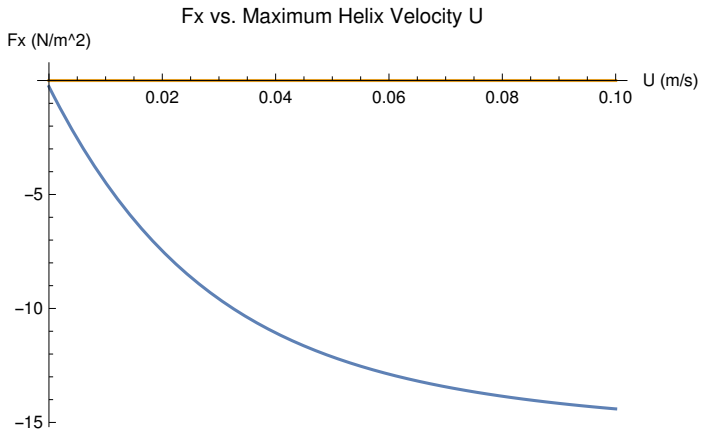
Let ϕ = 0.0366519



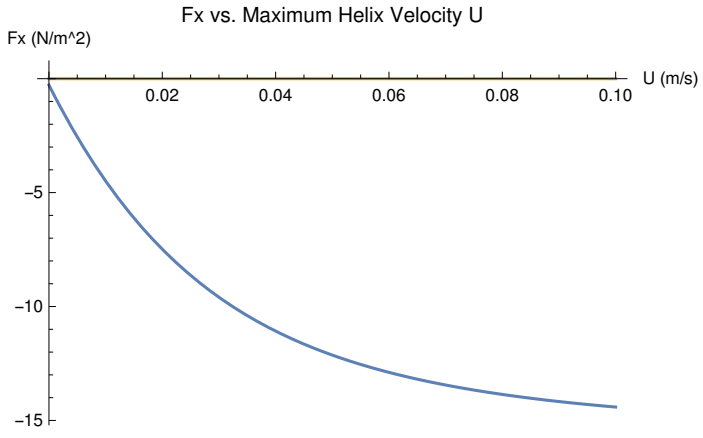
Let ϕ = 0.0383972



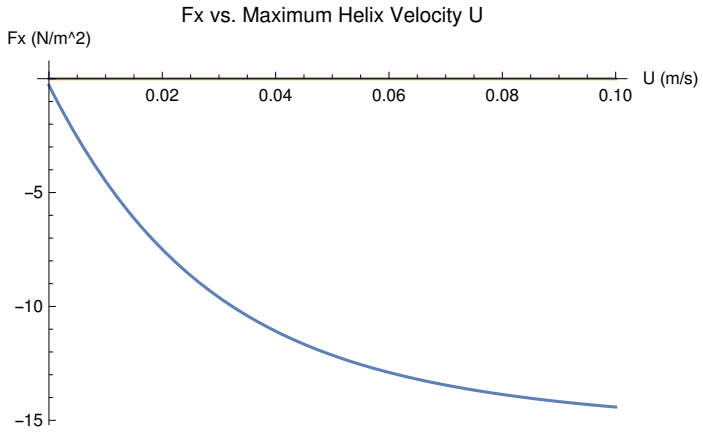
Let ϕ = 0.0401426



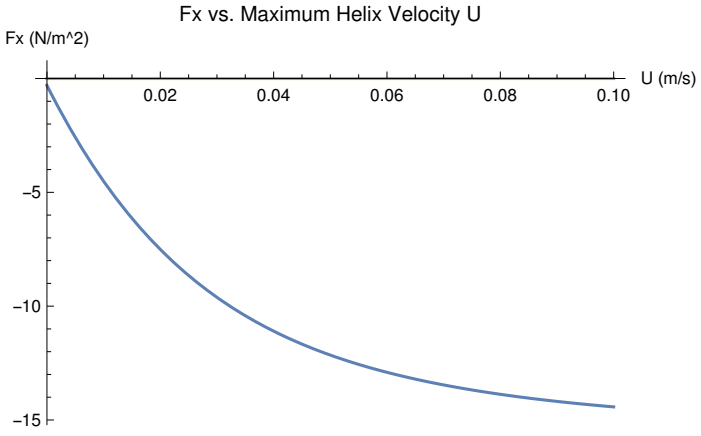
Let ϕ = 0.0418879



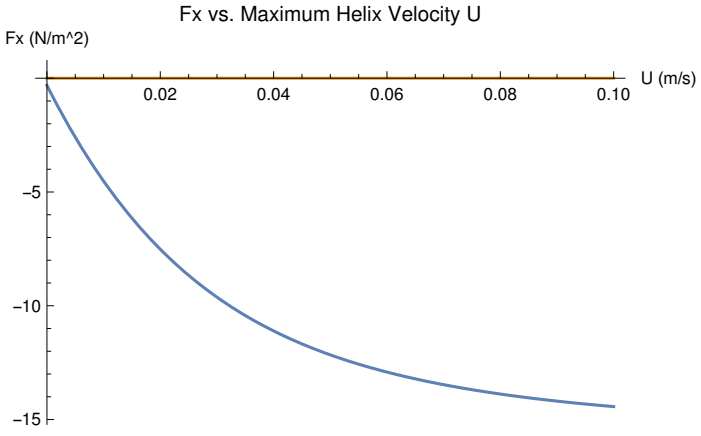
Let ϕ = 0.0436332



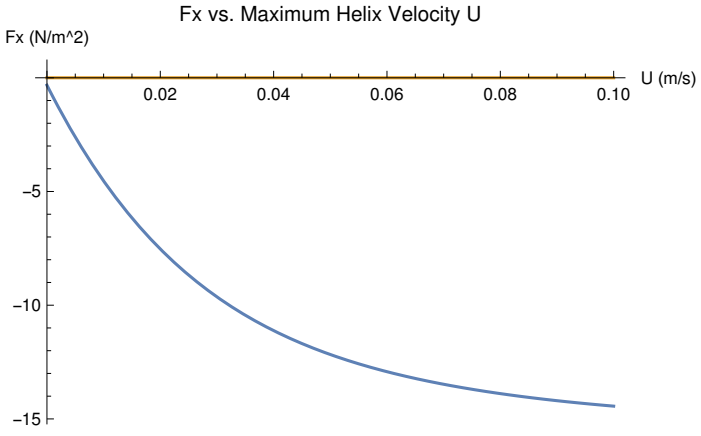
Let ϕ = 0.0453786



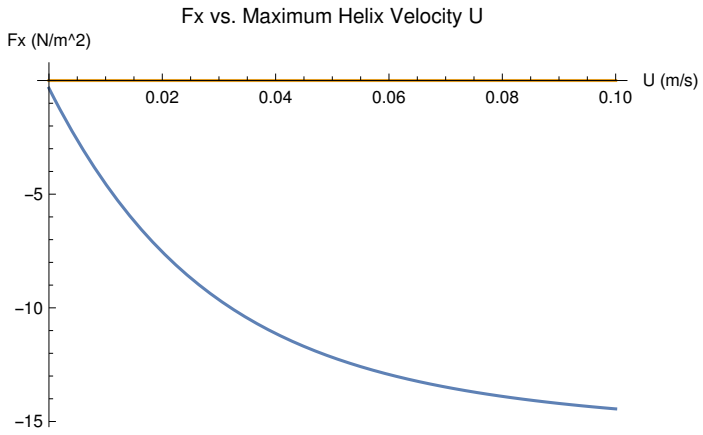
Let ϕ = 0.0471239



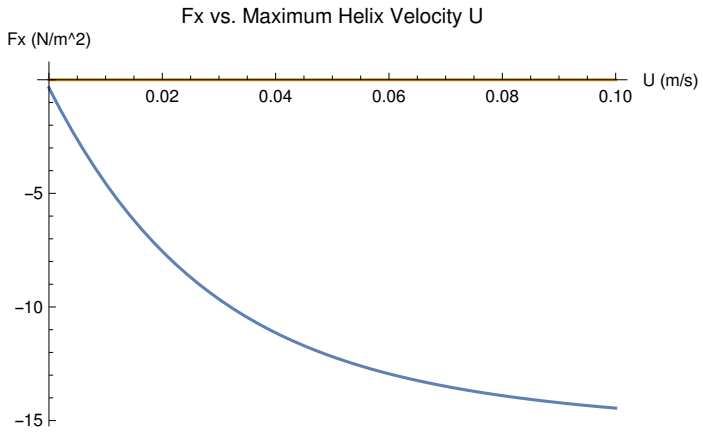
Let ϕ = 0.0488692



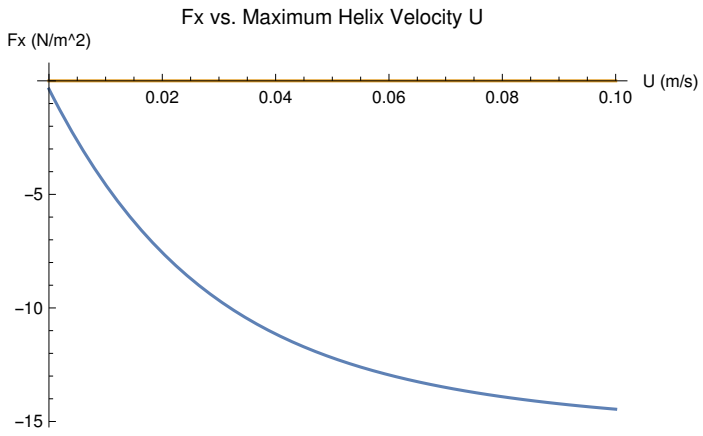
Let ϕ = 0.0506145



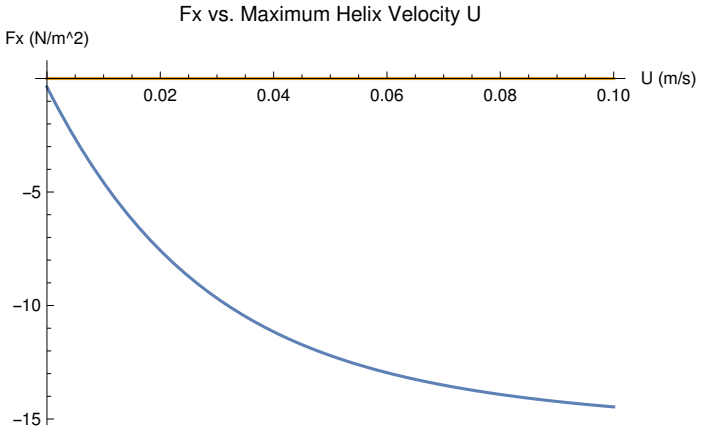
Let ϕ = 0.0523599



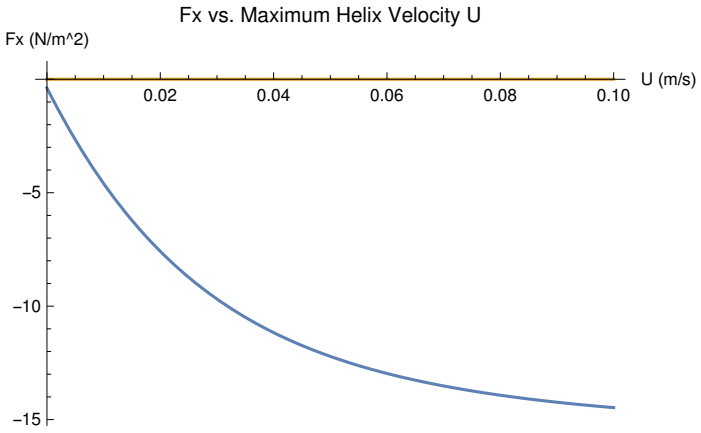
Let ϕ = 0.0541052



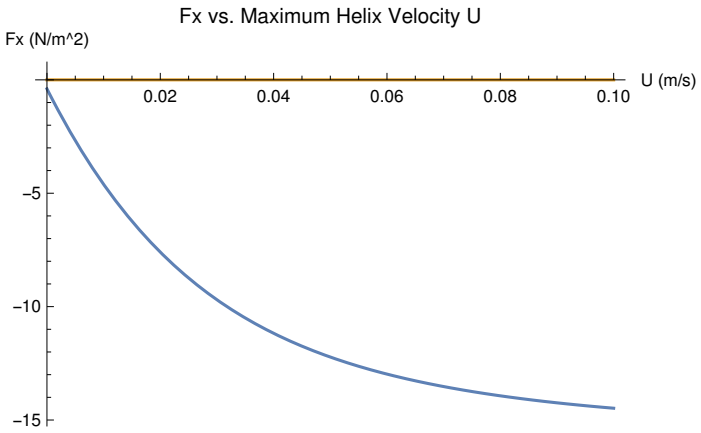
Let ϕ = 0.0558505



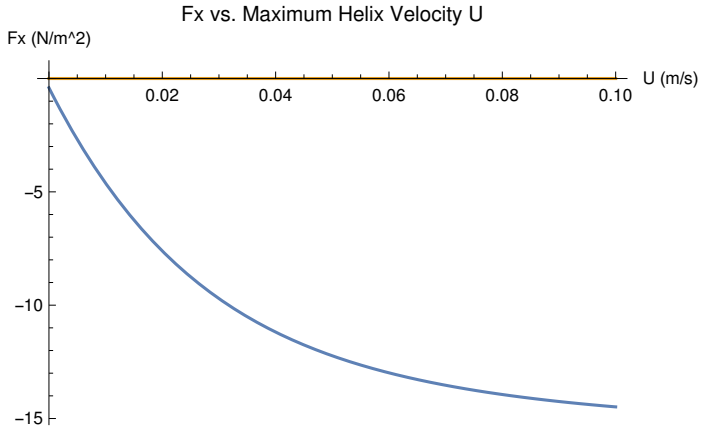
Let ϕ = 0.0575959



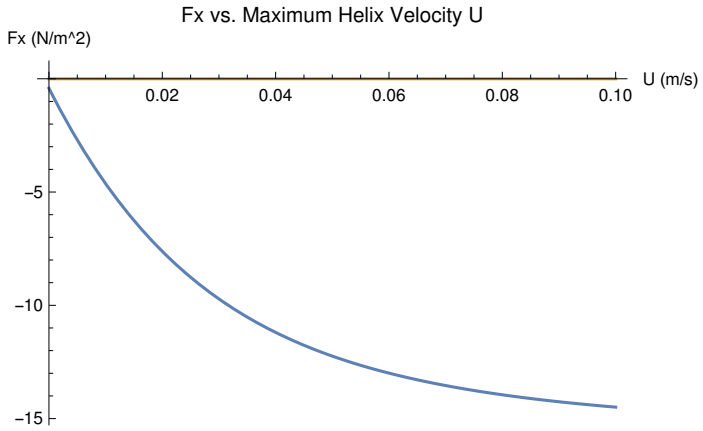
Let ϕ = 0.0593412



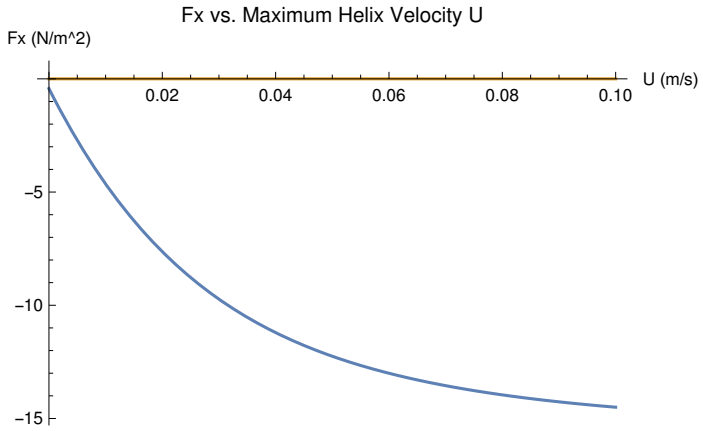
Let ϕ = 0.0610865



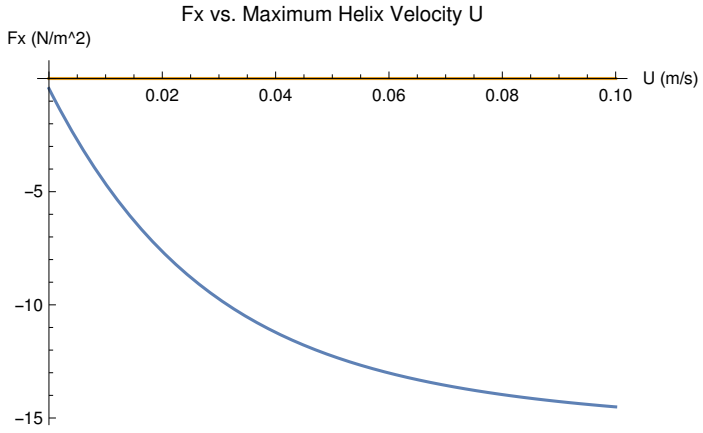
Let ϕ = 0.0628319



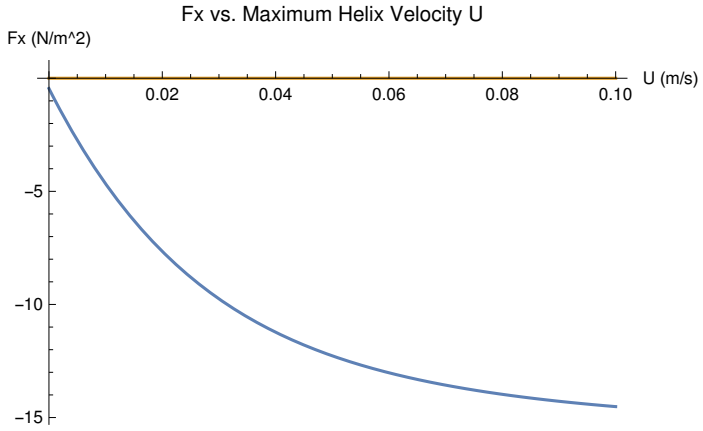
Let ϕ = 0.0645772



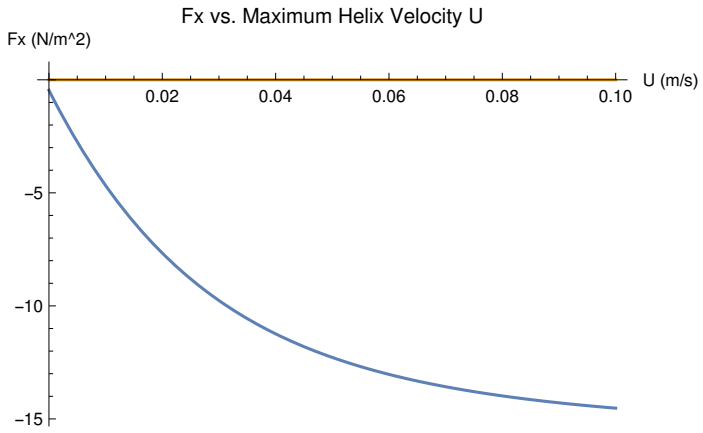
Let ϕ = 0.0663225



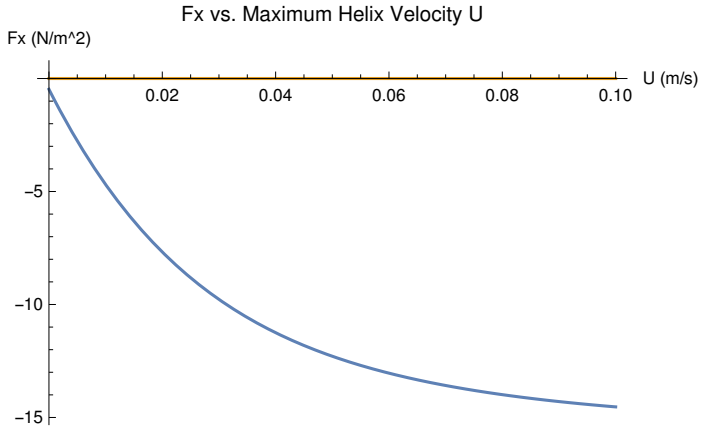
Let ϕ = 0.0680678



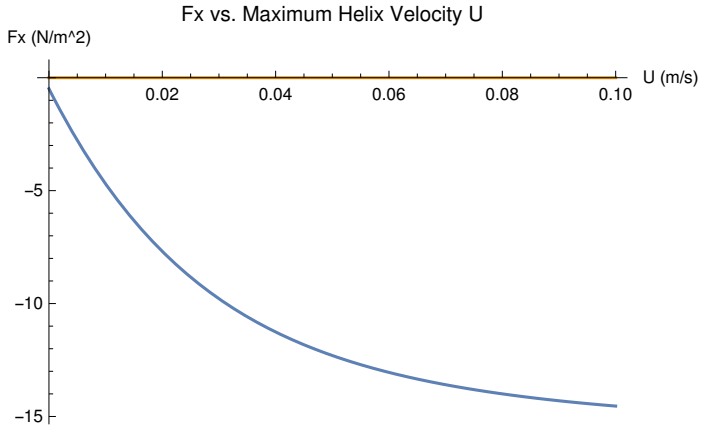
Let ϕ = 0.0698132



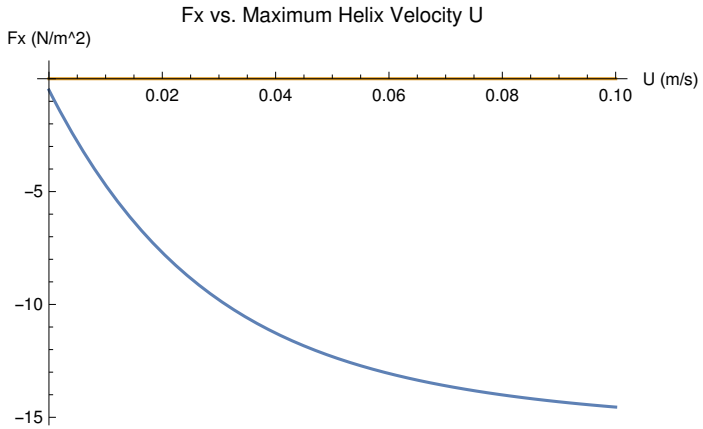
Let ϕ = 0.0715585



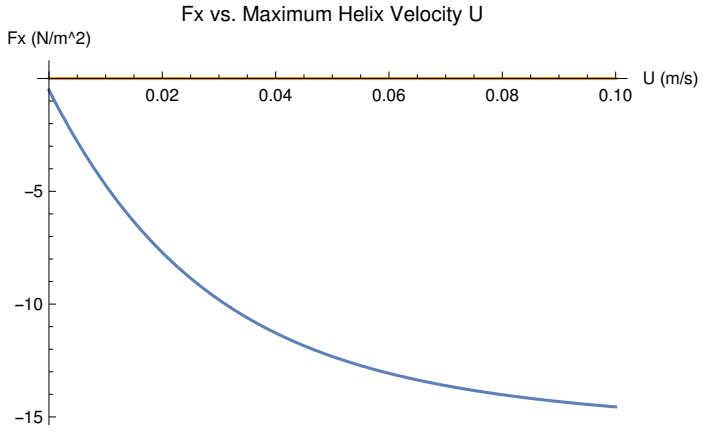
Let ϕ = 0.0733038



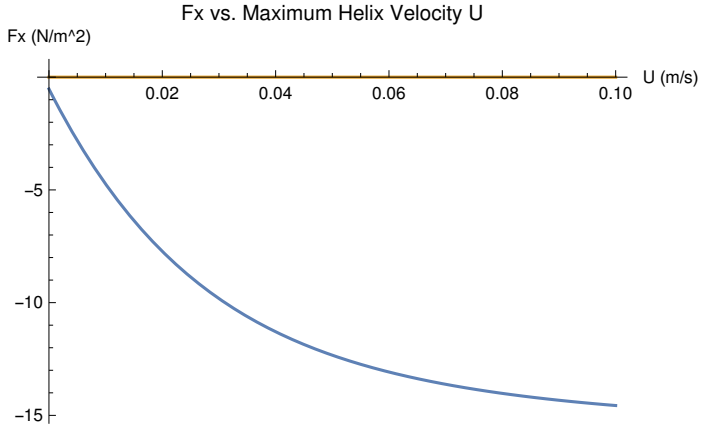
Let ϕ = 0.0750492



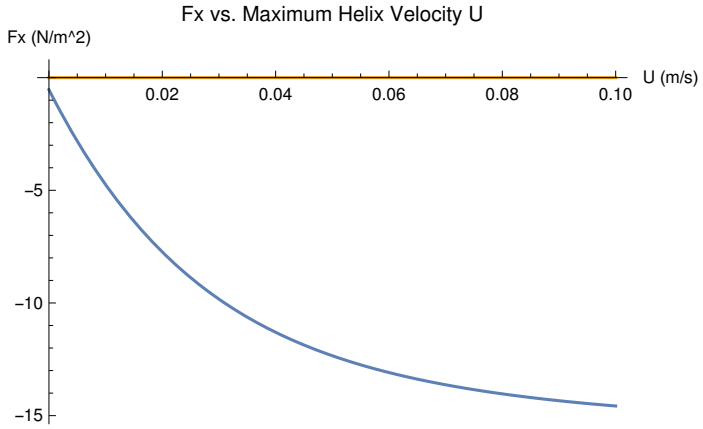
Let ϕ = 0.0767945



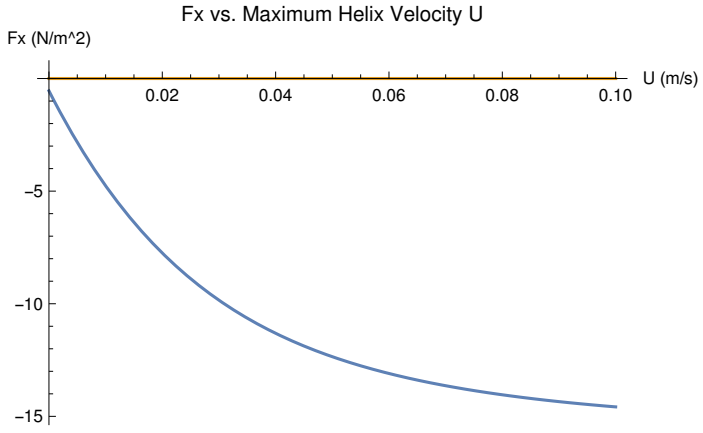
Let ϕ = 0.0785398



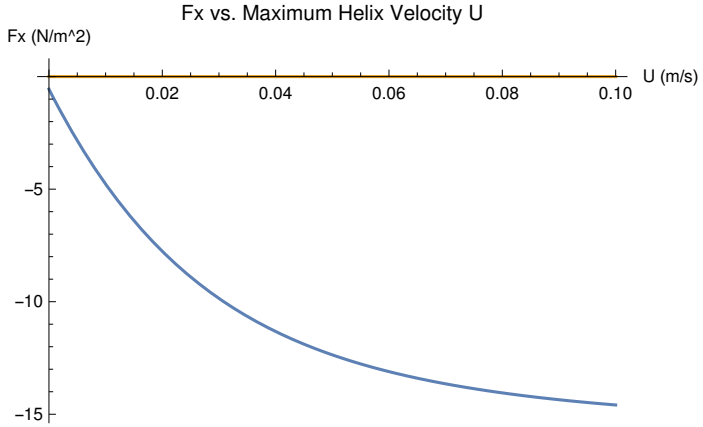
Let ϕ = 0.0802851



Let ϕ = 0.0820305



Let ϕ = 0.0837758



Let ϕ = 0.0855211