Design a reinforced concrete beam for the following conditions:

Span:	**34 ft**	
Live Load	**1,400 lb/ft**	
Dead Load:	**1,800 lb/ft**	
f_y:	**60,000 psi**	**(yield stress of steel)**
f_c':	**4,000 psi**	**(compressive strength of concrete)**

Find:

- V_u **(from Load and Span)**
- M_u **(from Load and Span)**
- b **(Assume beam width)**
- d **(find beam depth)**
- A_s **(find required area of tensile steel)**
- **bar size**
- **quantity of bars**
- **verify adequate width b**
- A_s **(find required area of shear steel)**
- **spacing of shear steel**
- **quantity of shear steel**

Known:	
Span	34ft
Live Load	1,400 lb/ft
Dead Load	1,800 lb/ft
f_y	60,000 psi
f_c'	4,000 psi
w (with overload factor)	
W *(with overload factor)*	

Find Factored Shear Force V_u

Step 1. Find the factor for overload U. Where D is the dead load and L is the live load

$U = 1.2D + 1.6L$

$U =$ *this can also be thought of as*: w

Step 2. Use shear force equation

$$V_u = \frac{W}{2}$$

Find the factored moment M_u

$$M_u = \frac{WL}{8}$$

Use table A.4 Balance Ratio of Reinforcement to find ρ

f_y	*60,000 psi*	*(yield stress of steel)*
f_c'	*4,000 psi*	*(compressive strength of concrete)*

$\rho_b =$
$\rho_{max} =$
$\rho_{rec} =$

Use table A.8 Beam Design Constants to find corresponding R value

$\rho_g =$
$R_n =$

Find nominal moment strength M_n (multiplied by understrength factor must be greater than or equal to factored load.

$\phi M_n = M_u$

$M_n = \frac{M_u}{\phi}$

$\phi = 0.9\ for\ flexture$

$M_n =$

Use the coefficient of resistance $R_n$equation to obtain d. Must choose b value. b = 16in

$R_n = \frac{M_n}{bd^2}$

$d^2 = \frac{M_n}{R_n b}$

$d =$

Note: $b \geq \frac{d}{3}\ and\ b \leq \frac{d}{2}$

Find required area of tensile steel A_s

$A_s = \frac{M_u}{\phi f_y (0.9d)}$

$A_s =$

Check A_s minimum and maximum

Minimum:

$$A_s = \frac{\left(200\frac{lb}{in^2}\right)(bd)}{f_y}$$

$A_s =$

Maximum:

$A_s = 0.75\rho_b bd$

$A_s =$

Use table 27.3 Properties of Reinforcing Bars to choose a bar No. and quantity

$A_s =$

Bar No. ___:

Area:

Diameter:

Weight:

Use _____

Verify adequate width b

2 (____)	To the face of the concrete
_ (____)	Diameter of No. 9
_ (____)	Between Bars
2 (?)	diameter of shear stirrups

$\_\_\_\_\_ + 2(\ ?\ ) \leq b$