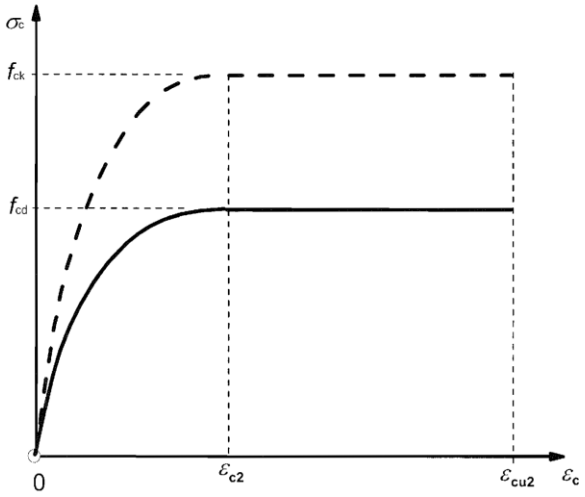
# 1. Concrete Curve Selection

## 1.1. IRC112: Recto-Parabolic




$$f_{cd} = \frac{\alpha f_{ck}}{\gamma_m}$$

where
$\alpha = 0.67$

$$\sigma_c = f_{cd}\left[1-\left(1-\frac{\varepsilon_c}{\varepsilon_{c2}}\right)^n\right] \quad \text{for} \quad 0 \le \varepsilon_c \le \varepsilon_{c2}$$

$$\sigma_c = f_{cd} \quad \text{for} \quad \varepsilon_{c2} \le \varepsilon_c \le \varepsilon_{cu2}$$

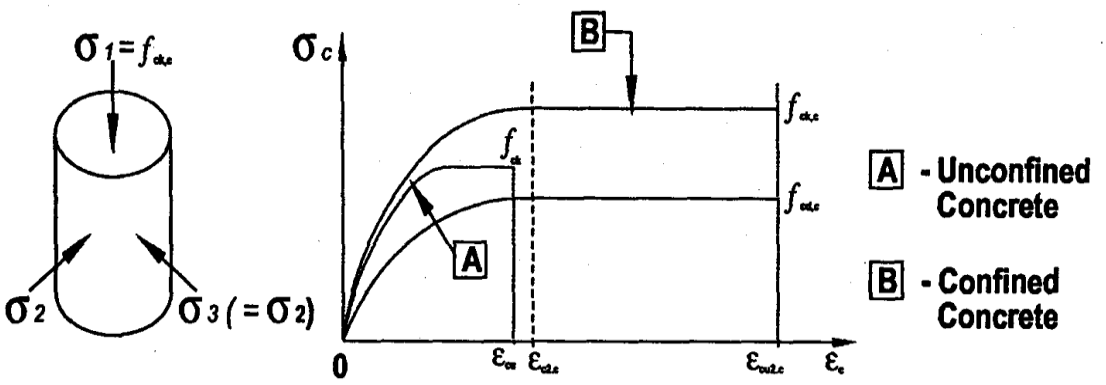
Where,

| | | |
|---|---|---|
| $\eta$ | = | Exponent as given in Table 6.5 |
| $\varepsilon_{c2}$ | = | Strain at reaching characteristic strength as given in Table 6.5 |
| $\varepsilon_{cu2}$ | = | Ultimate strain as given in Table 6.5 |
| $\gamma_m$ | = | Material factor as provided in Input file under "Material Properties" |

Section

| | |
|---|---|
| ***NOTE:*** | *Apart from Material properties, program only reads Ultimate/Limiting Strain ($\varepsilon_{cu}$), Strain at Characteristic Strength ($\varepsilon_c$) and Exponent ($\eta$) from the Input file to generate the above curve.* |

## 1.2. IRC112: Confined



$$f_{ck,c} = f_{ck}\left(1 + 5\sigma_2 / f_{ck}\right) \text{ for } \sigma_2 \le 0.05 f_{ck} \qquad \textbf{Eq. A2-29}$$

$$f_{ck,c} = f_{ck}\left(1.125 + 2.5\sigma_2 / f_{ck}\right) \text{ for } \sigma_2 > 0.05 f_{ck} \qquad \textbf{Eq. A2-30}$$

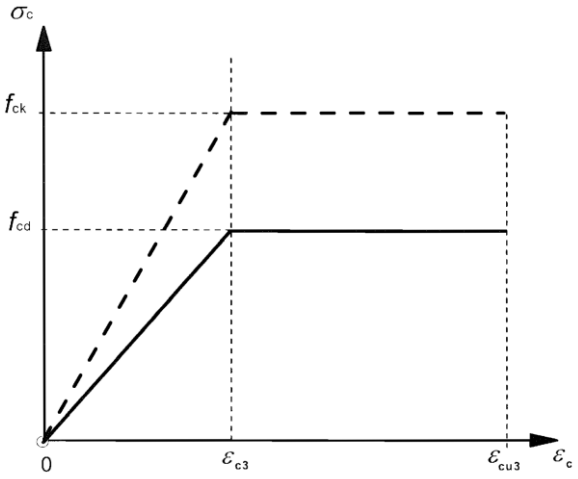
$$\varepsilon_{c2,c} = \varepsilon_{c2}\left(f_{ck,c} / f_{ck}\right)^2 \qquad \textbf{Eq. A2-31}$$

$$\varepsilon_{cu2,c} = \varepsilon_{cu2} + 0.2\sigma_2 / f_{ck} \qquad \textbf{Eq. A2-32}$$

Where $\sigma_2 (= \sigma_3)$ is the effective lateral compressive stress at the ULS due to confinement and $\varepsilon_{c2}$ and $\varepsilon_{cu2}$ follow from **Table 6.5.** Confinement can be achieved by adequately closed links or cross-ties, which reach the plastic condition due to lateral extension of the concrete.

| | |
|---|---|
| ***NOTE:*** | *Apart from Material properties, program only reads Ultimate/Limiting Strain ($\varepsilon_{cu}$), Strain at Characteristic Strength ($\varepsilon_c$), Exponent ($\eta$) and Effective Lateral Compressive Stress ($\sigma_2$) from the Input file to generate the above curve, using equations given above.* |

## 1.3. IRC112: Bilinear




$$f_{cd} = \frac{\alpha f_{ck}}{\gamma_m}$$

where

$\alpha = 0.67$

Where,

| | | |
|---|---|---|
| $\varepsilon_{c3}$ | = | Strain at reaching characteristic strength as given in Table 6.5 |
| $\varepsilon_{cu3}$ | = | Ultimate strain as given in Table 6.5 |
| $\gamma_m$ | = | Material factor as provided in Input file under "Material Properties" |

Section

| | |
|---|---|
| ***NOTE:*** | *Apart from Material properties, program only reads Ultimate/Limiting Strain ($\varepsilon_{cu}$) and Strain at Characteristic Strength ($\varepsilon_c$) from the Input file to generate the above curve.* |

### 1.4. IRS: Parabolic or BS5400: Parabolic

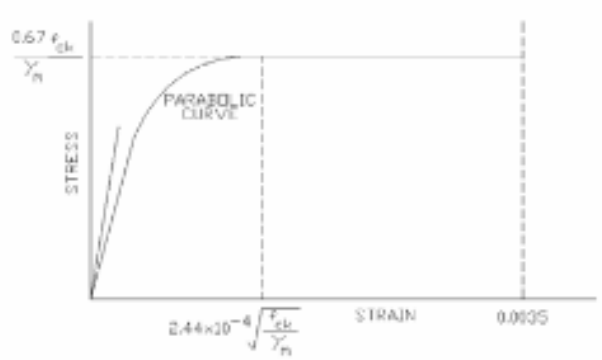



**FIG3**: SHORT TERM DESIGN STRESS STRAIN CURVE FOR NORMAL WEIGHT CONCRETE

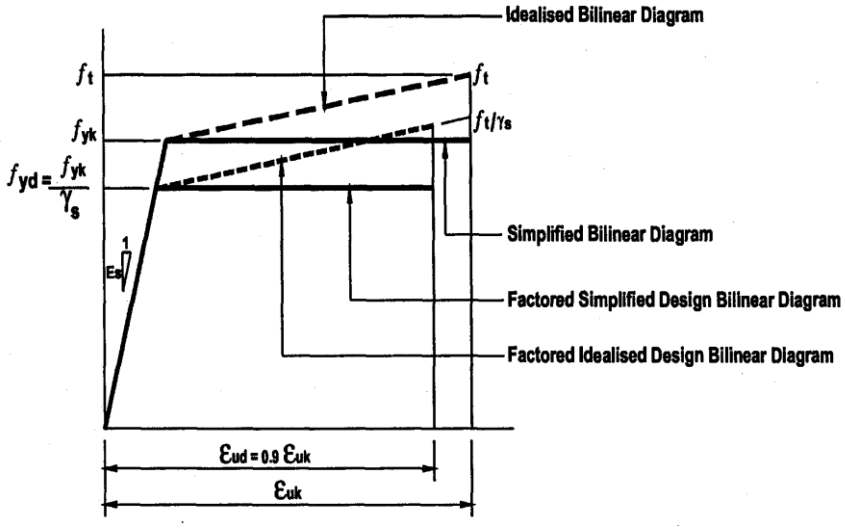
Equation for the parabolic curve between $\varepsilon = 0$ and $\varepsilon = 2.44 \times 10^{-4} \sqrt{(f_{ck} / \gamma_m)}$, may be taken as

$$f = \left[5500 \sqrt{\frac{f_{ck}}{\gamma_m}}\right] \varepsilon - \left[\frac{5500^2}{2.68}\right] \varepsilon^2$$

| | |
|---|---|
| ***NOTE:*** | *Apart from Material properties, program only reads Ultimate/Limiting Strain ($\varepsilon_{cu}$) from the Input file to generate the above curve.* |

## 2. Reinforcement Steel Curve Selection

### 2.1. IRC112: Idealised Bilinear or IRC112: Simplified Bilinear




| | |
|---|---|
| ***NOTE:*** | *Apart from Material properties, program reads from the Input file to generate the above curve as follows:*<br>*i. In order to generate the Stress Strain curve as per IRC112, "Ultimate/Limiting Strain ($\varepsilon_{uk}$)" (given in Table 18.1 of IRC112) and "Ratio of $\varepsilon_{uk}$ & Design Strain ($\varepsilon_{ud}$)" is a must input.*<br>*ii. Additionally, if Idealised Bilinear Curve option is selected, then the "Ratio of $f_t/f_{yk}$" (given in Table 18.1 of IRC112) is required to calculate "$f_t$".* |

| | |
|---|---|
| | *Where, $f_{yk}$ is the Yield strength ($F_y$) of reinforcement steel as provided in the input file under "Material Properties" Section.* |

## 2.2. IRS: Fig4A or IRS: Fig4B

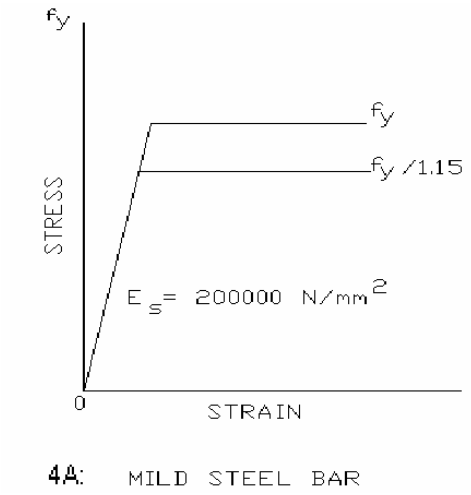



**FIG 4**: REPRESENTATIVE STRESS STRAIN CURVE FOR REINFORCEMENT

| | |
|---|---|
| ***NOTE:*** | *Apart from Material properties, program only reads Ultimate/Limiting Strain ($\varepsilon_{uk}$) from the Input file to generate the above curve.* |

### 2.3. BS5400: Fig2

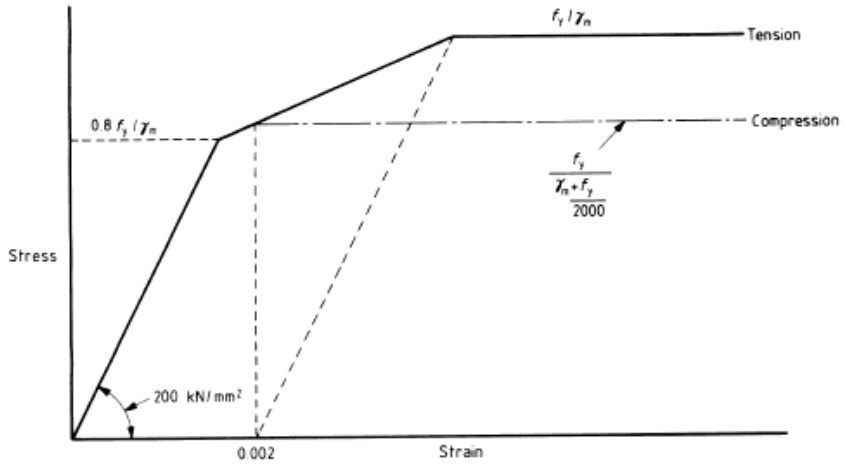
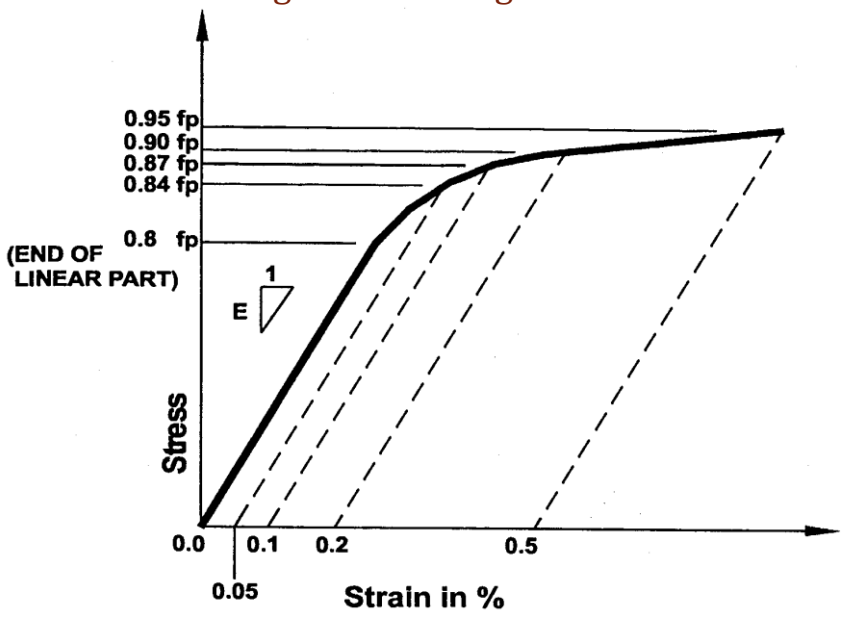



Figure 2 — Short term design stress-strain curve for reinforcement

| | |
|---|---|
| ***NOTE:*** | *Apart from Material properties, program only reads Ultimate/Limiting Strain ($\varepsilon_{uk}$) from the Input file to generate the above curve.* |

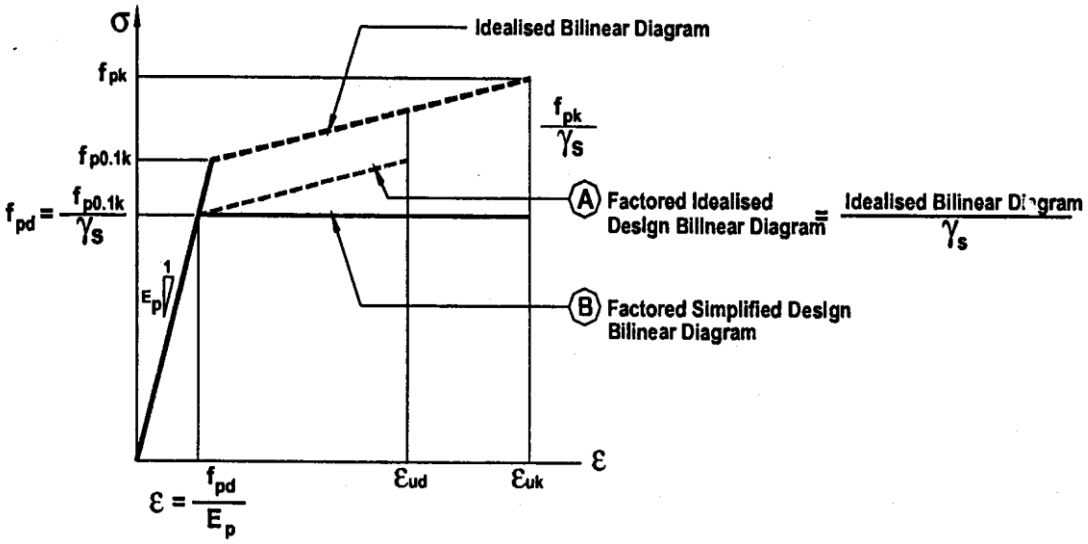
## 3. Prestressing Steel Curve Selection

### 3.1. IRC112: Fig6.3 or IRS: Fig2A




| | |
|---|---|
| ***NOTE:*** | *Program only reads Ultimate Strength of Prestressing Steel from Material properties from the Input file to generate the above curve.* |

## 3.2. IRC112: Idealised Bilinear or IRC112: Simplified Bilinear




| | |
|---|---|
| ***NOTE:*** | *Apart from Material properties, program reads Ultimate/Limiting Strain ($\varepsilon_{uk}$) and Ratio of $f_{p0.1k}$/ $f_{pk}$ from the Input file to generate the curve for Simplified Bilinear Diagram. Additionally, if Idealised Bilinear Diagram is selected, program reads Ratio of $\varepsilon_{uk}$ & Design Strain ($\varepsilon_{ud}$) also.* |

## 3.3. IRS: Fig2B

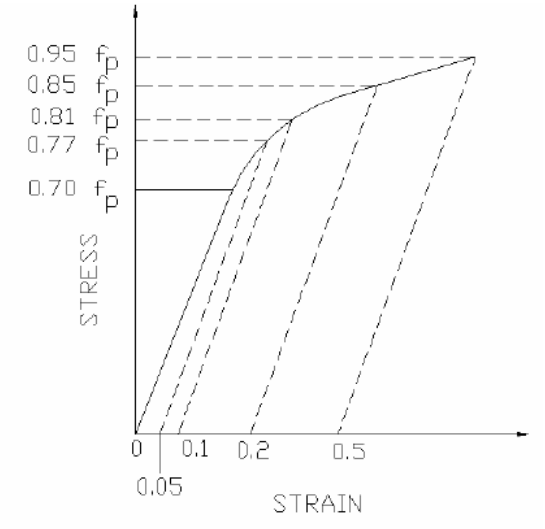



FIG 2B: WIRES (AS DRAWN) REPRESENTATIVE STRESS STRAIN CURVES FOR PRE-STRESSING STEEL

| | |
|---|---|
| ***NOTE:*** | *Program only reads Ultimate Strength of Prestressing Steel from Material properties from the Input file to generate the above curve.* |

## 3.4. IRS: Fig2 or BS5400: Fig3

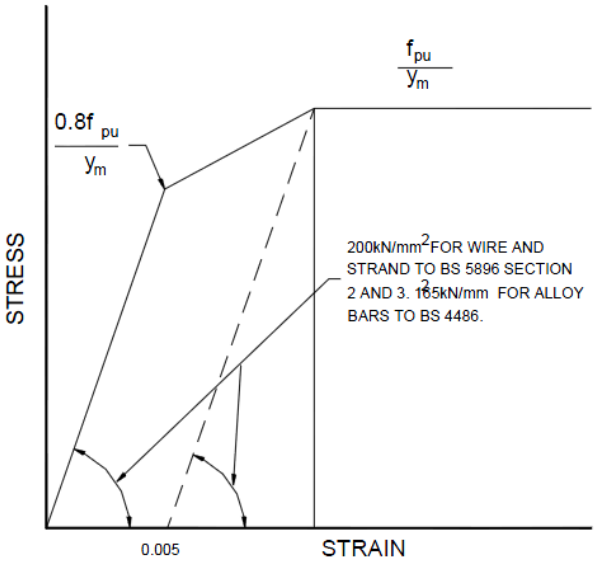



Fig. 2. Short term design stress strain curve for normal and for low relaxation products.

| | |
|---|---|
| ***NOTE:*** | *Apart from Material properties, program only reads Ultimate/Limiting Strain ($\varepsilon_{uk}$) from the Input file to generate the above curve.* |