Total System costs for assignments ①, ② and ③

$$\boxed{f = x_1 c_1(x_1) + x_2 c_2(x_2)}$$

① $x_1 = 0 \qquad x_2 = d$

$c_1(0) = \infty \qquad c_2(d) = 3 + d$

$$f_{①} = 0 \times \infty + d \times (3+d) = \underline{\underline{3d + d^2}}$$

② $x_1 = d \qquad x_2 = 0$

$c_1(d) = 1 + \frac{1}{d} \qquad c_2(0) = 3$

$= \frac{d+1}{d}$

$$f_{②} = d \times \frac{d+1}{d} + 0 \times 3 = \underline{\underline{d+1}}$$

③ $c_1(x_1) = c_2(x_2)$

using $x_1 = 0.5 \qquad x_2 = 0$

$c_1(x_1) = 3 \qquad c_2(x_2) = 3$

$$f_{③} = 0.5 \times 3 + 0 \times 3 = \underline{\underline{1.5}}$$

invalid as $x_2 \geq 0$ condition

~~using $x_1 = 2 \qquad x_2 = -1.5$~~

~~$c_1(x_1) = 1.5 \qquad c_2(x_2) = 1.5$~~

$$\cancel{f_{③} = 2 \times 1.5 - 1.5 \times 1.5 = 0.75}$$

Summary:

$f_{①} = 3d + d^2 \qquad [x_1 = 0, x_2 = d]$

$f_{②} = d + 1 \qquad [x_1 = d, x_2 = 0]$

$f_{③} = 1.5 \qquad [c_1(x_1) = c_2(x_2)]$

$[x_1 = 0.5, x_2 = 0]$

Using Minimum demand $d = 0.5$:

$f_{①} = \underline{\underline{1.75}}$

$f_{②} = \underline{\underline{1.5}}$

$f_{③} = \underline{\underline{1.75}}$

Reminder: c_1, x_1 in relation to public transport

c_2, x_2 in relation to congestible choice (e.g. car traffic)

i.e. $f_{①}$ relates to car traffic only

$f_{②}$ and $f_{③}$ are for public transport only.