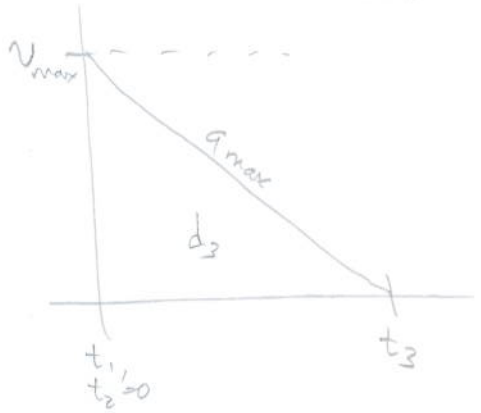
No cruise or accel phases, only decel phase

if $d < d_3$, no cruise/accel



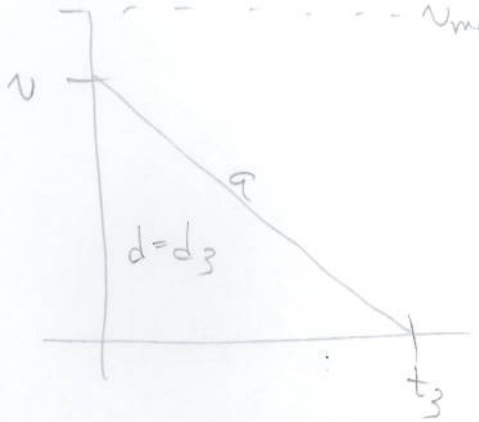
$$a_{max} t_3 = v_{max} \rightarrow t_3 = \frac{v_{max}}{a_{max}}$$

$$d_3 = \frac{1}{2} t_3 v_{max}$$

$$d_3 = \frac{v_{max}^2}{2a_{max}}$$

If $\boxed{d < \frac{v_{max}^2}{2a_{max}}}$ no cruise/accel.

Then,



Overconstrained w/ d, v, a. Relax a.

$$\frac{1}{2} t_3 v = d \rightarrow \boxed{t_3 = \frac{2d}{v}}$$

$$v = a t_3 \rightarrow \boxed{a = \frac{v}{t_3}}$$

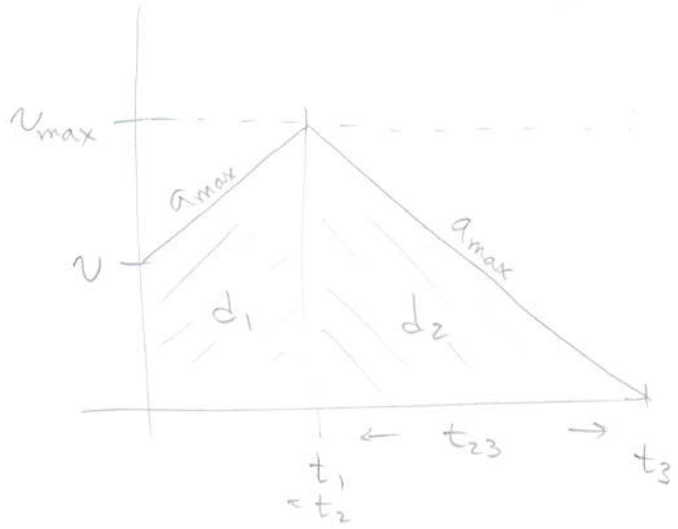
$t_1 = t_2 = 0$

$d_{t_1} = d_{t_2} = 0$

$t_3 = \frac{2d}{v}$

* new $\boxed{a_{max} = \frac{v}{t_3}}$

No cruise phase:



if $d < d_1 + d_2$, no cruise phase.

$v + a_{max} t_1 = v_{max}$

$t_1 = \frac{v_{max} - v}{a_{max}}$

$d_1 = t_1 \cdot (v + v_{max}) \cdot \frac{1}{2}$

$= \frac{1}{2} \frac{(v_{max} + v)(v_{max} - v)}{a_{max}}$

$t_{23} = t_3 - t_1 \quad (t_2 = t_1)$

$v_{max} = a_{max} t_{23}$

$t_{23} = \frac{v_{max}}{a_{max}}$

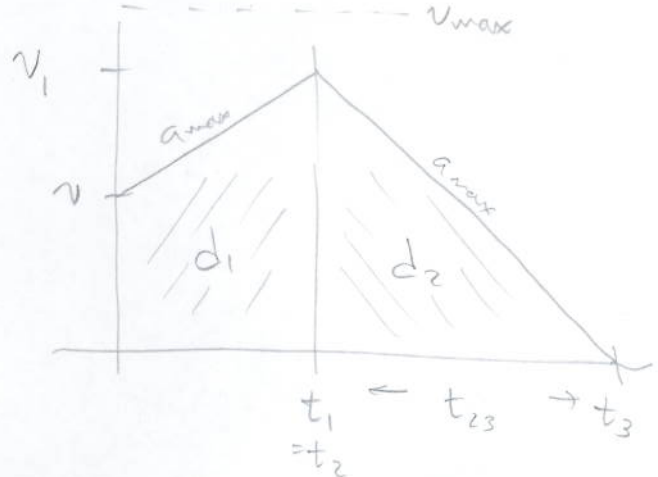
$d_2 = \frac{1}{2} \cdot t_{23} \cdot v_{max}$

$= \frac{1}{2} \frac{v_{max}^2}{a_{max}}$

$d_1 + d_2 = \frac{v_{max}^2 - v^2}{2a_{max}} + \frac{v_{max}^2}{2a_{max}} = \frac{2v_{max}^2 - v^2}{2a_{max}} = \frac{v_{max}^2 - \frac{1}{2}v^2}{a_{max}}$

if $d < \frac{v_{max}^2 - \frac{1}{2}v^2}{a_{max}}$, no cruise phase.

Then, redo w/ $v_{max} = v_1$, $v_1 = v + a_{max} t_1$:



← this figure applies

→ ③

(3)

$v + a_{max} t_1 = v_1$

$d_1 = t_1 \cdot \frac{(v + v + a_{max} t_1)}{2}$

$t_{23} = t_3 - t_1 \quad (t_2 = t_1)$

$v_1 = a_{max} t_{23}$

$t_{23} = \frac{v_1}{a_{max}}$

$d_2 = \frac{1}{2} \frac{v_1}{a_{max}} v_1$

$= \frac{v_1^2}{2a_{max}}$

$= \frac{(v + a_{max} t_1)^2}{2a_{max}}$

$d = d_1 + d_2$

$= \frac{2vt_1 + a_{max} t_1^2}{2} + \frac{v^2 + 2va_{max} t_1 + a_{max}^2 t_1^2}{2a_{max}}$

$2a_{max} d = 2va_{max} t_1 + a_{max}^2 t_1^2 + v^2 + 2va_{max} t_1 + a_{max}^2 t_1^2$

$2a_{max}^2 t_1^2 + 4va_{max} t_1 + v^2 - 2a_{max} d = 0$

$t_1 = \frac{-4va_{max} \pm \sqrt{16v^2 a_{max}^2 t_1^2 - 4(2a_{max}^2)(v^2 - 2a_{max} d)}}{4a_{max}^2}$

$= \frac{-4va_{max} \pm 2a_{max}\sqrt{2(v^2 + 2ad)}}{4a_{max}^2}$

$= \frac{-4va_{max} + 4a_{max}\sqrt{\frac{1}{2}(v^2 + 2ad)}}{4a_{max}^2}$

$$t_1 = \frac{-v + \sqrt{\frac{1}{2}(v^2 + 2ad)}}{a_{max}}$$

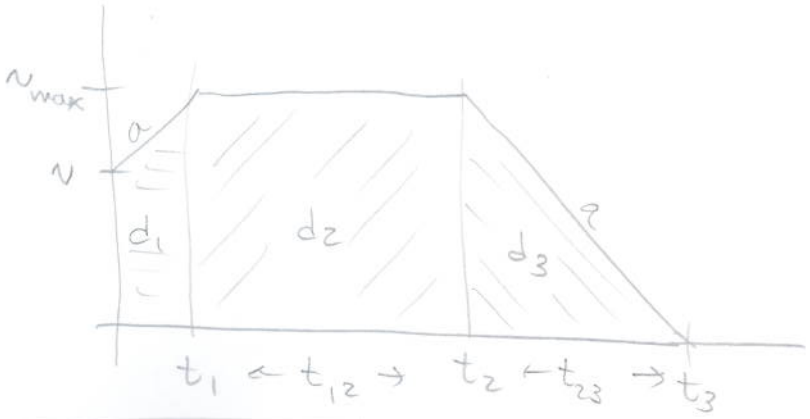
→ (4)

$$t_3 = t_1 + t_{23} = t_1 + \frac{v_1}{a_{max}} = t_1 + \frac{v + a t_1}{a}$$

$$\boxed{t_3 = 2t_1 + v/a}$$

$$dt_1 = \left(\frac{2v + a_{max} t_1}{2}\right) t_1$$

Otherwise, we have a cruise phase:



$$\boxed{t_1 = \frac{v_{max} - v}{a_{max}}}$$

$$t_{23} = \frac{v_{max}}{a_{max}}$$

$$\boxed{d_1 = t_1 \cdot \tfrac{1}{2}(v + v_{max})}$$

$$\boxed{d_3 = \tfrac{1}{2} t_{23} v_{max} = \tfrac{1}{2} \frac{v_{max}^2}{a_{max}}}$$

$$\boxed{d_2 = d - d_1 - d_3}$$

$$d_2 = t_{12} \cdot v_{max}$$

$$\rightarrow t_{12} = \frac{d_2}{v_{max}}$$

$$\boxed{t_2 = t_1 + t_{12} = t_1 + \frac{d_2}{v_{max}}}$$

$$\boxed{t_3 = t_2 + v_{max}/a_{max}}$$