Heights constr

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$$hS_1 + hS_2 + \text{bird jump}\,(x) \leq \textcircled{?}\;(TV)$$

$$|hS_1 - hS_2| \geq x \qquad \text{total screen height}$$
$$\text{(NDC)}$$

So that bird can jump
without hitting the pipe (enough gap is there)

Labels on figure:
- S_2
- $\left(0, \frac{TV-x}{h}\right)$
- $\left(0, \frac{x}{h}\right)$
- $S_1 = S_2 - \frac{x}{h}$
- $S_1 = S_2$
- $\left(\frac{TV-2x}{2h}, \frac{TV}{2h}\right)$
- $S_1 = S_2 + \frac{x}{h}$
- $\left(\frac{TV}{2h}, \frac{TV-2x}{2h}\right)$
- eligible region
- $\left(\frac{x}{h}, 0\right)$
- $\left(\frac{TV-x}{h}, 0\right)$
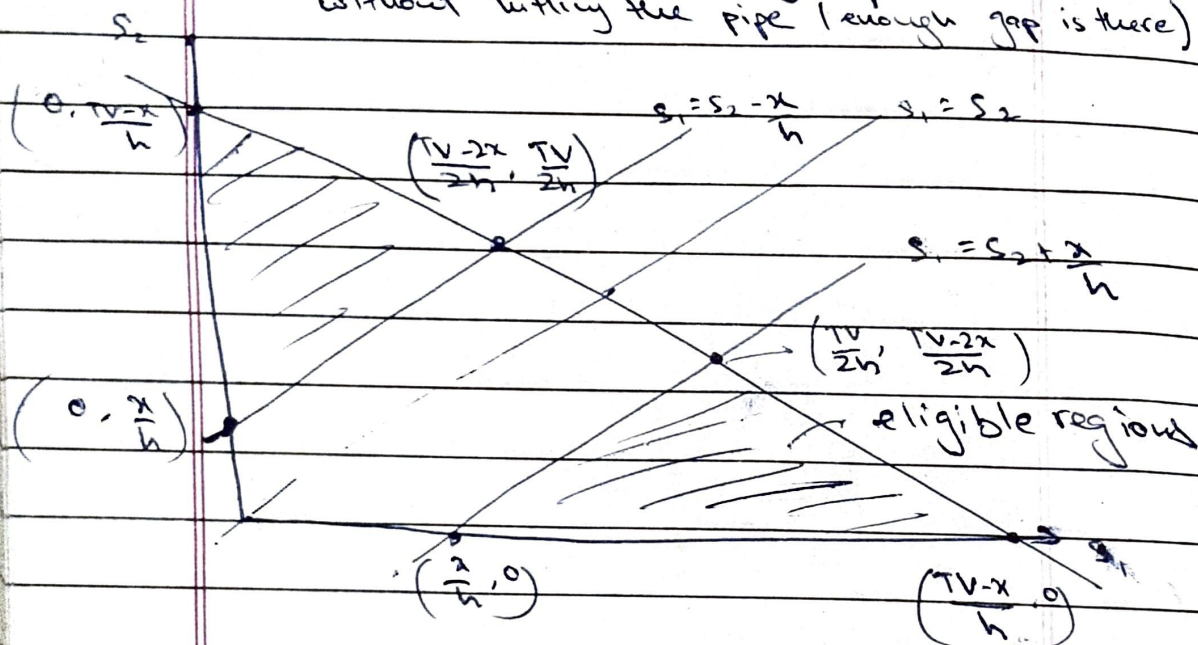
- if $\quad \dfrac{x}{h} < \dfrac{TV-2x}{2h}$

  - if $S_1 < x/h$

    $$S_1 + x/h < S_2 < \frac{TV-x}{h} - S_1$$

  - if $x/h < S_1 < \dfrac{TV-2x}{2h}$ $\left. \begin{array}{c} \end{array}\right) \textcircled{1}$

    or

    $$0 < S_2 < S_1 - x/h \quad \textcircled{2}$$

  - if $\dfrac{TV-2x}{2h} < S_1 < \dfrac{TV}{2h}$ $\left. \begin{array}{c} \end{array}\right) \textcircled{1}$

    or

  - if $\dfrac{TV}{2h} < S_1 < \dfrac{TV-x}{h}$

    $$0 < S_2 < \frac{TV-x}{h} - S_1$$

- elif $\quad x/h > \dfrac{TV-2x}{2h}$

- if $S_1 < \dfrac{TV - 2x}{2h}$
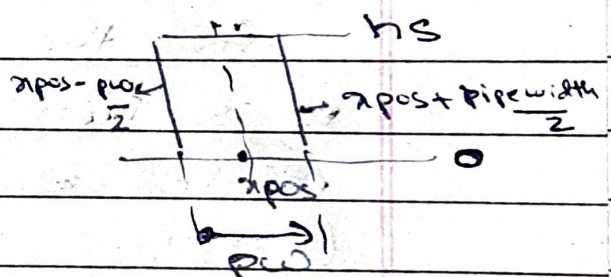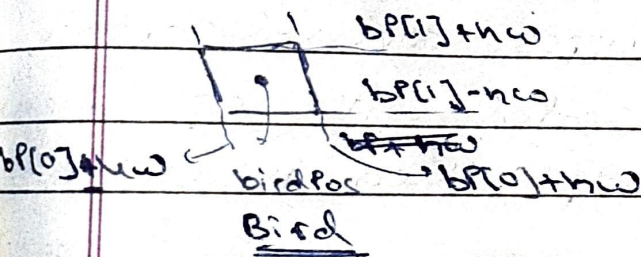
  $S_1 + \dfrac{x}{h} < S_2 < \dfrac{TV - x}{h} - S_1$

- if $\dfrac{x}{h} < S_1 < TV/2h$

  $0 < S_2 < S_1 - x/h$

- if $\dfrac{TV}{2h} < S_1 < \dfrac{TV - x}{h}$

  $0 < S_2 < \dfrac{TV - x}{h} - S_1$

Collision check


```
bP[1]+hw
bP[1]-hw
birdPos      bP[0]+hw
Bird

                    hs
xpos- pw/2         xpos+ pipewidth/2
                    0
         xpos
```

bP[0]+hw

case 1)

left edge < $xpost \dfrac{pw}{2}$ < right edge

case (2)

$xpost \dfrac{pw}{2}$ > right edge

$xpos - \dfrac{pw}{2}$ < left edge

case 3)

left edge < $xpos - \dfrac{w}{2}$ < right edge

in all the cases

upper edge $\geq$ $1 - h s_2$
(bird)

lower edge $<$ $h s_1 - 1$

for collision to take place

Original pipes designed as

$-\frac{w}{2}, h$ ┌──────────┐ $w/2, h$

$\left(\frac{-w}{2}, 0\right)$ $\left(\frac{w}{2}, 0\right)$

for the upper reversed section,

it is first scaled with s_2, then

rotated @ $180°$ then translated by

$(0, 1, 0)$

The lower pipe scaled s_1 and translated

by $(0, -1, 0)$