Optimum Design of Side mirror

한양대학교 기계공학부

카센타  이영준, 유재석

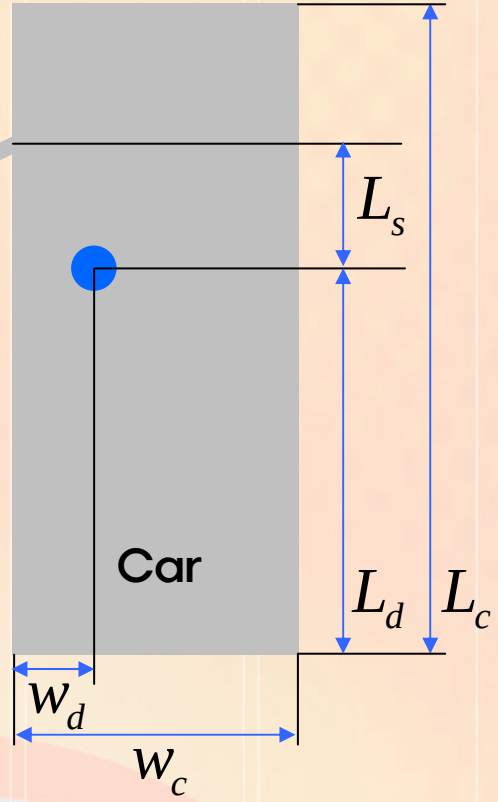
Side mirror

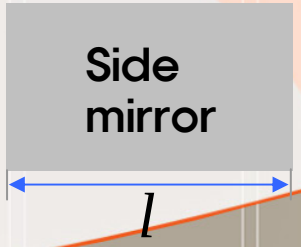
차량의 운전석과 조수석 쪽

문에 달려 옆과 후방을 볼 수 있는 반사경

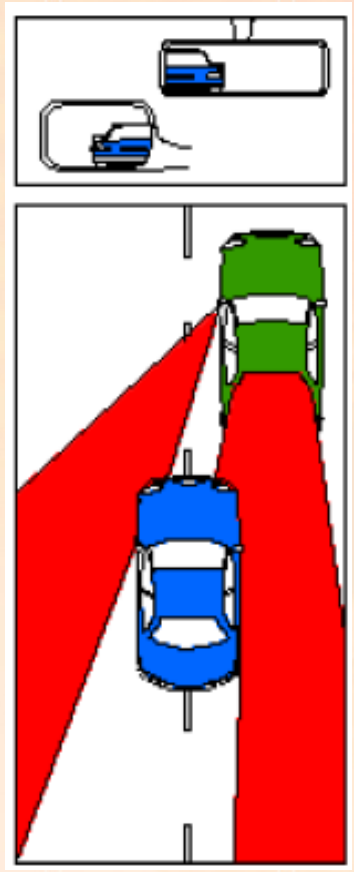
Modeling

직사각형으로 모델링





Step1 : Project/Problem Statement



눈 또는 거울로도

보이지 않는 사각지대 존재

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Side mirror의 중요성

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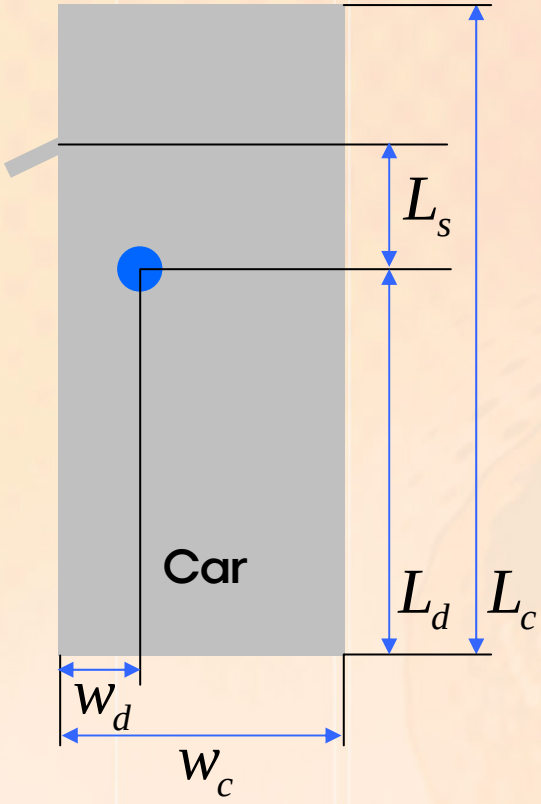
사각지대를 위한
Side mirror의 최적화

Step2 : Data and information collection



w_c = 자동차 폭 : 1720 *mm*

L_c = 자동차 길이 : 4510 *mm*

L_d = 운전자와 자동차 뒷 범퍼까지 거리 : 2360 *mm*

L_s = 운전자와 side mirror까지 세로 거리 : 570 *mm*

w_d = 운전자와 side mirror까지 가로 거리 : 470 *mm*

w_L = 도로 폭 길이 : 3500 *mm*

L_{ss} = 안전거리(시속 50km/h) : 35 *m*

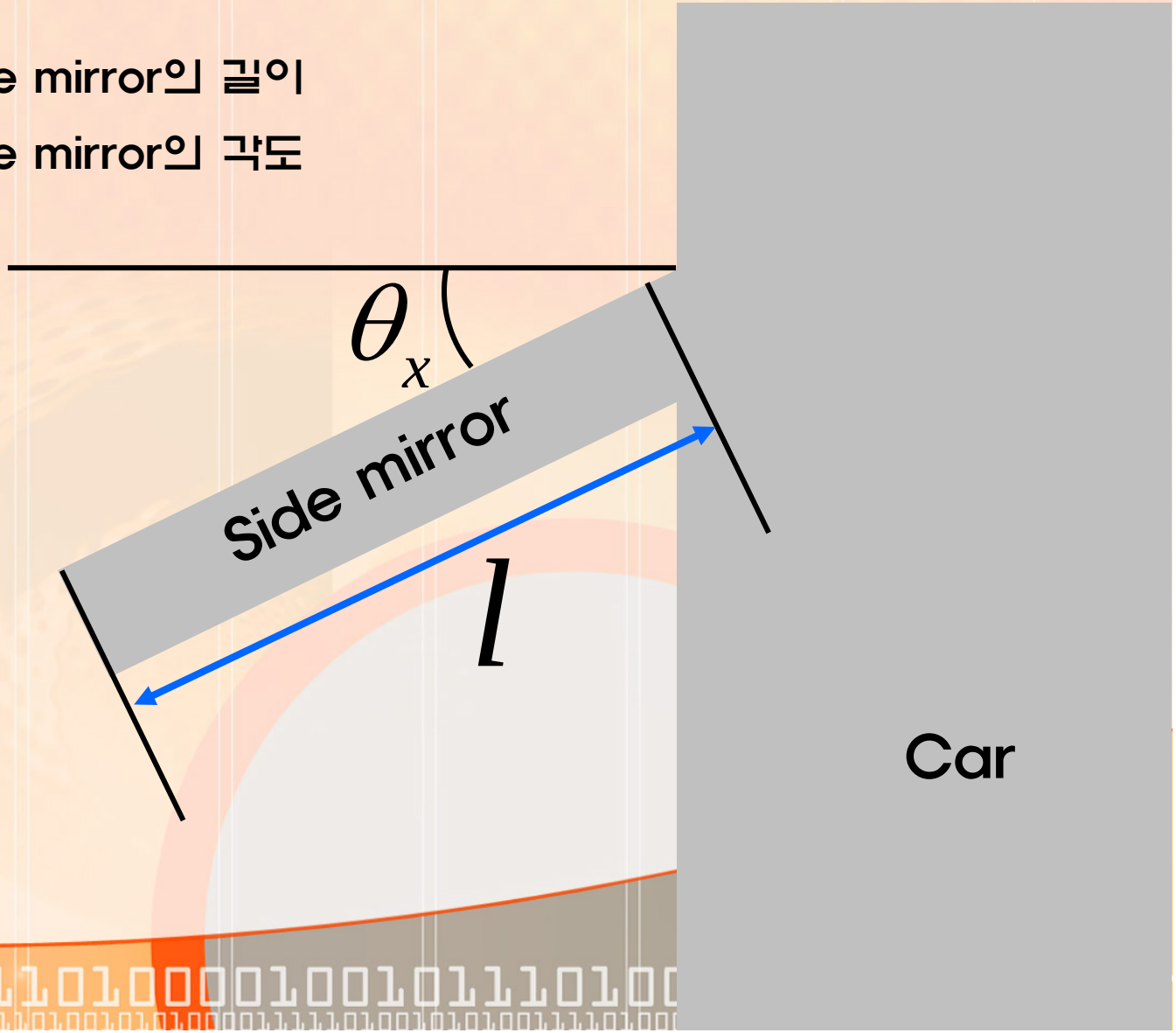
(Avante XD 기준)

Step3 : Identification/Definition

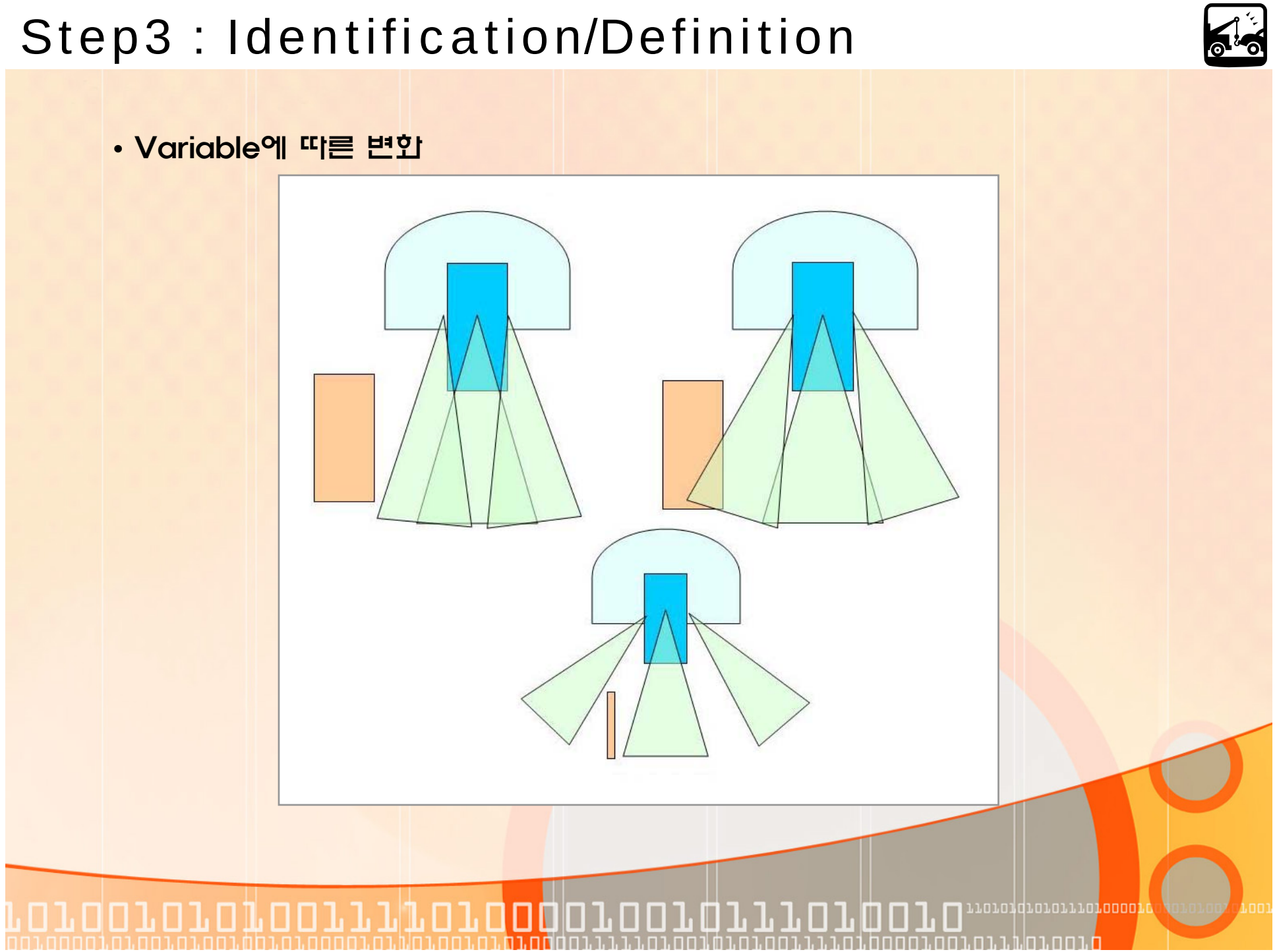
Variable : l, θ_x

l : side mirror의 길이

θ_x : side mirror의 각도



Step3 : Identification/Definition

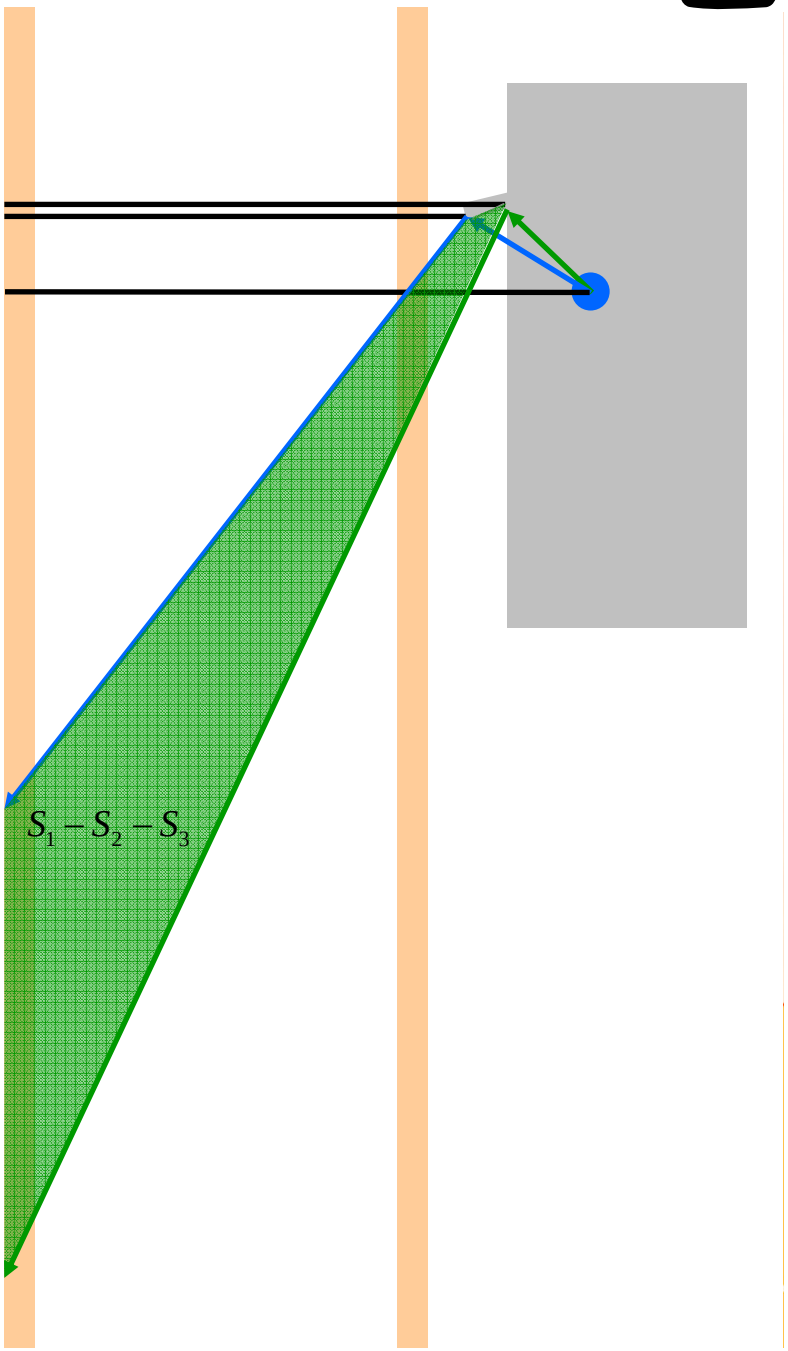


- Variable에 따른 변화

Step4 : Identification of a Criterion to Be Optimized

Minimize :

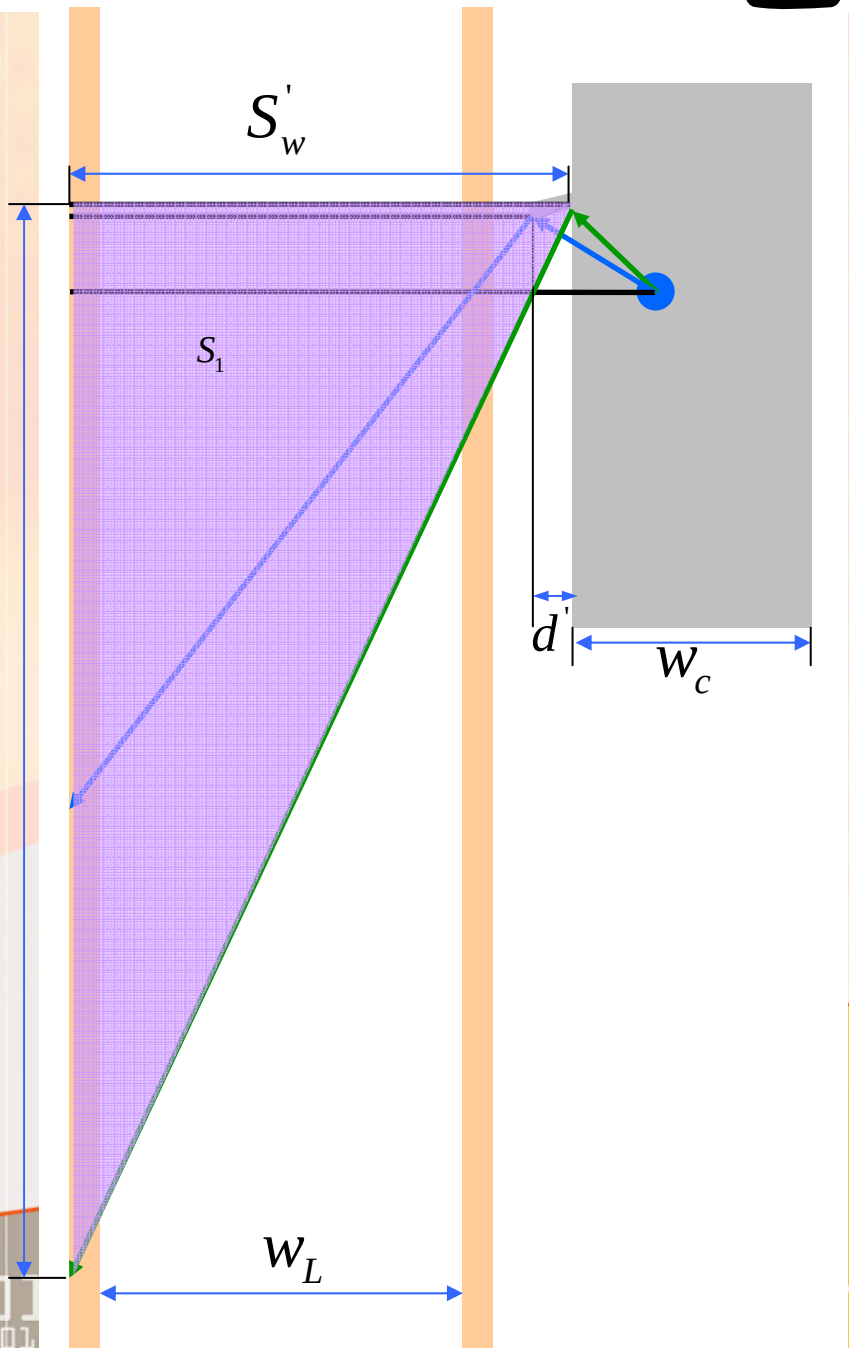
$$f = S_1 - S_2 - S_3$$



Step4 : Identification of a Criterion to Be Optimized

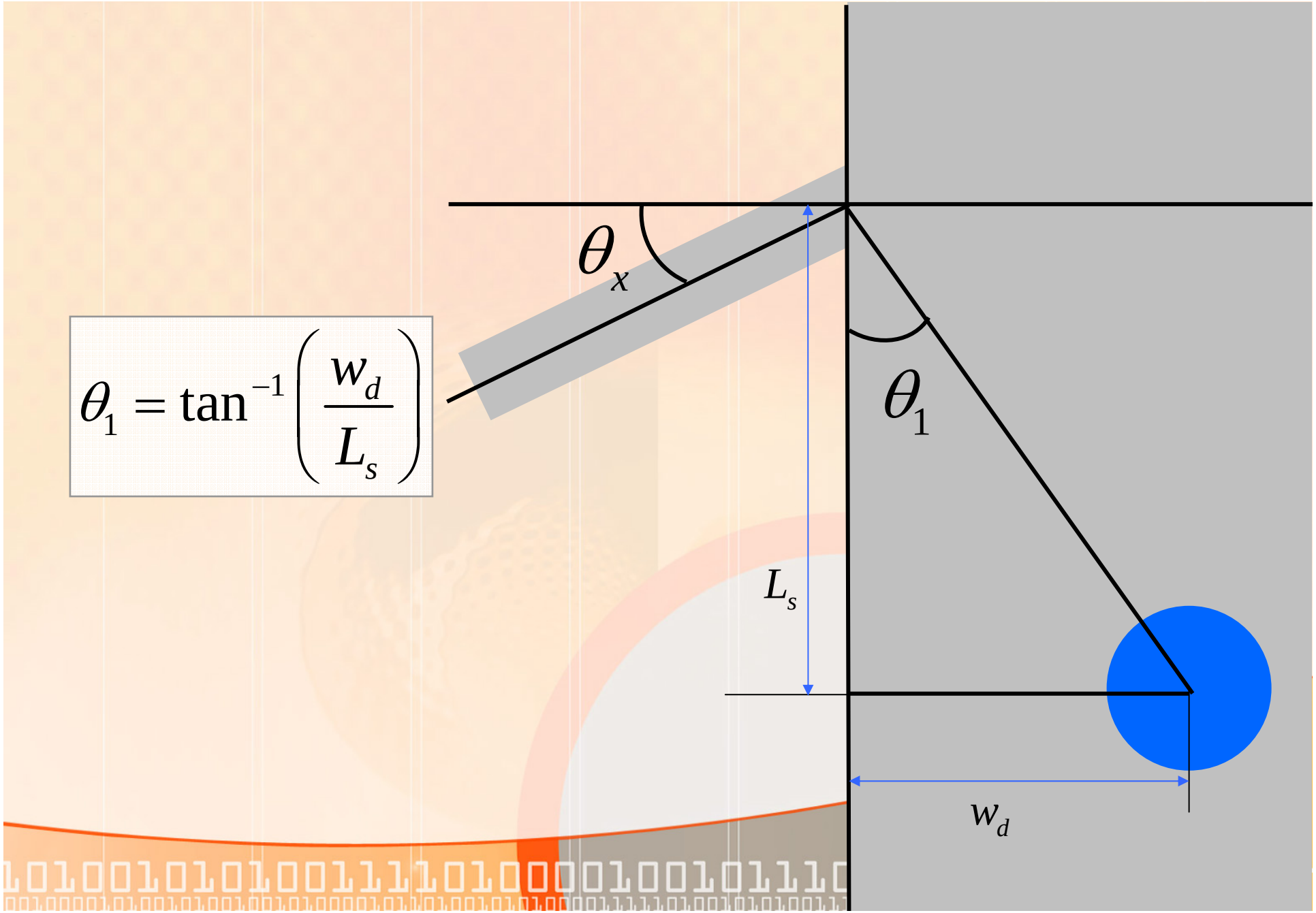
유도과정 : S_1

$$S_1 = \frac{\tan\left(\frac{\pi}{2} - \theta_1 + 2\theta_x\right)\left(\frac{3}{2}w_L - \frac{w_c}{2}\right)^2}{2}$$



Step4 : Identification of a Criterion to Be Optimized

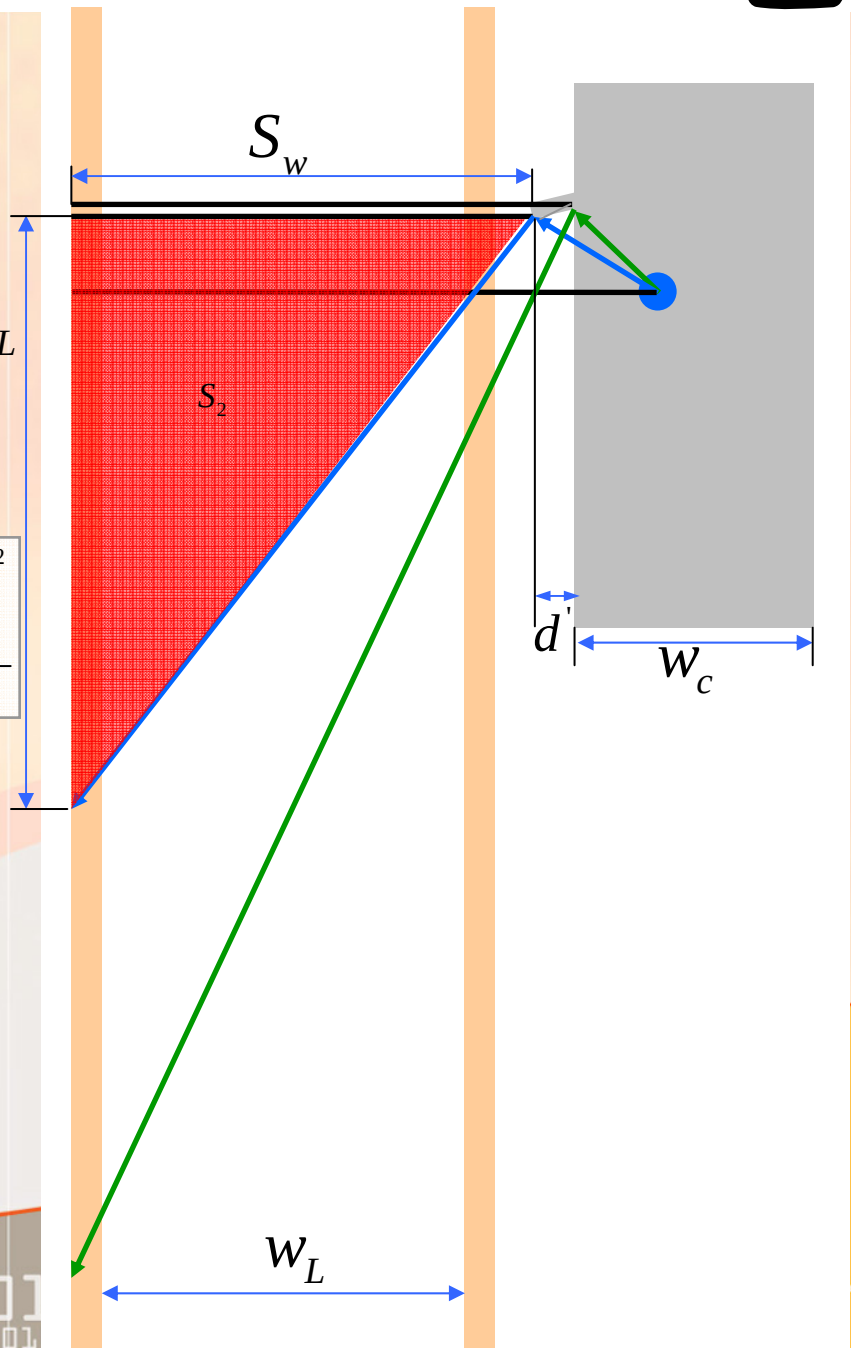
$$\theta_1 = \tan^{-1}\left(\frac{w_d}{L_s}\right)$$



Step4 : Identification of a Criterion to Be Optimized

유도과정 : S_2

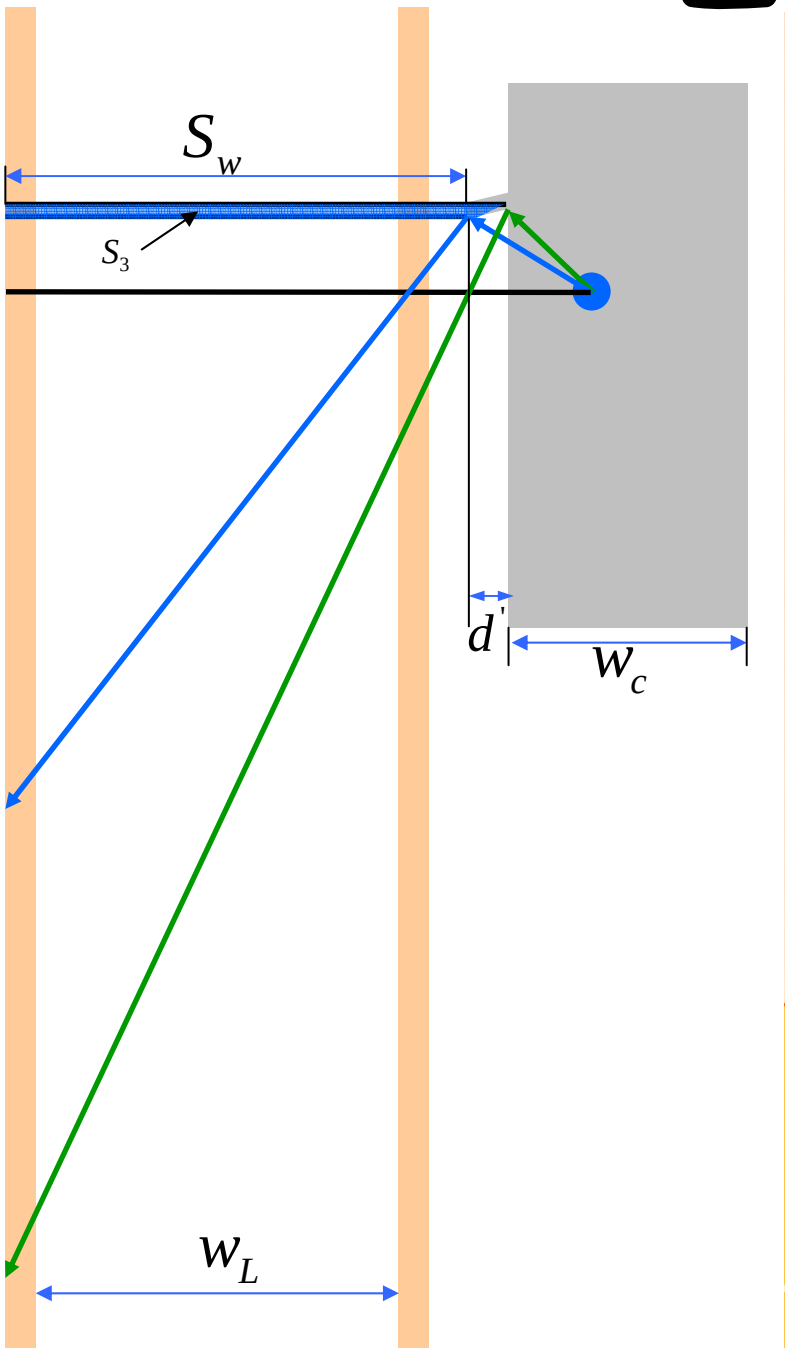
$$S_2 = \frac{\tan\left(\frac{\pi}{2} - \tan^{-1}\left(\frac{w_d + l\cos\theta_x}{L_s - l\sin\theta_x}\right) + 2\theta_x\right)\left(\frac{3}{2}w_L - \frac{w_c}{2} - l\cos\theta_x\right)^2}{2}$$



Step4 : Identification of a Criterion to Be Optimized

유도과정 : S_3

$$S_3 = \frac{\left(3w_L - w_c - l\cos\theta_x\right)}{2} l\sin\theta_x$$



Step4 : Identification of a Criterion to Be Optimized

$$f = S_1 - S_2 - S_3$$

$$S_1 = \frac{\tan\left(\frac{\pi}{2} - \theta_1 + 2\theta_x\right)\left(\frac{3}{2}w_L - \frac{w_c}{2}\right)^2}{2}$$

$$S_2 = \frac{\tan\left(\frac{\pi}{2} - \tan^{-1}\left(\frac{w_d + l\cos\theta_x}{L_s - l\sin\theta_x}\right) + 2\theta_x\right)\left(\frac{3}{2}w_L - \frac{w_c}{2} - l\cos\theta_x\right)^2}{2}$$

$$S_3 = \frac{(3w_L - w_c - l\cos\theta_x)}{2} l\sin\theta_x$$

$$f = \frac{\tan\left(\frac{\pi}{2} - \theta_1 + 2\theta_x\right)\left(\frac{3}{2}w_L - \frac{w_c}{2}\right)^2}{2} - \frac{\tan\left(\frac{\pi}{2} - \tan^{-1}\left(\frac{w_d + l\cos\theta_x}{L_s - l\sin\theta_x}\right) + 2\theta_x\right)\left(\frac{3}{2}w_L - \frac{w_c}{2} - l\cos\theta_x\right)^2}{2} - \frac{(3w_L - w_c - l\cos\theta_x)}{2} l\sin\theta_x$$

Step5 : Identification of Constraints

- 자동차 면에 대한 제약조건

$$\theta_x \le \frac{\theta_1}{2}$$

- 안전거리에 대한 제약조건

$$\theta_x \ge \frac{1}{2}\left(\theta_1 - \tan^{-1}\frac{w_c}{L_{ss} + L_s + L_d}\right)$$

- 도로 폭에 대한 제약조건

$$l \le \frac{\left(w_L - w_c\right)}{2\cos\theta_x}$$

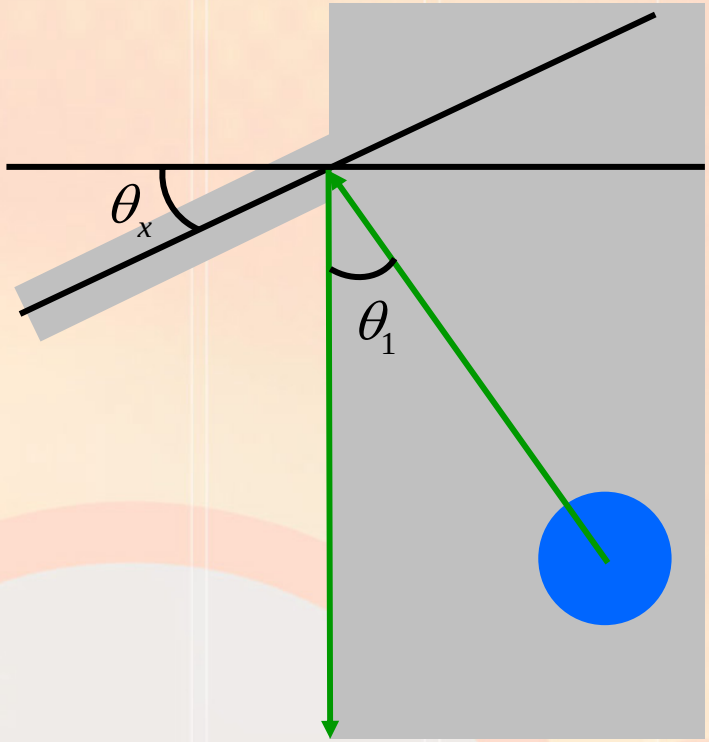
- 옆 차선 자동차에 대한 제약조건

$$l \ge \frac{w_L - w_c - \tan\theta_p^{`}\left(L_s + L_c\right)}{\cos\theta_x - \sin\theta_x \tan\theta_p^{`}}$$

Step5 : Identification of Constraints

- 자동차 면에 대한 제약조건

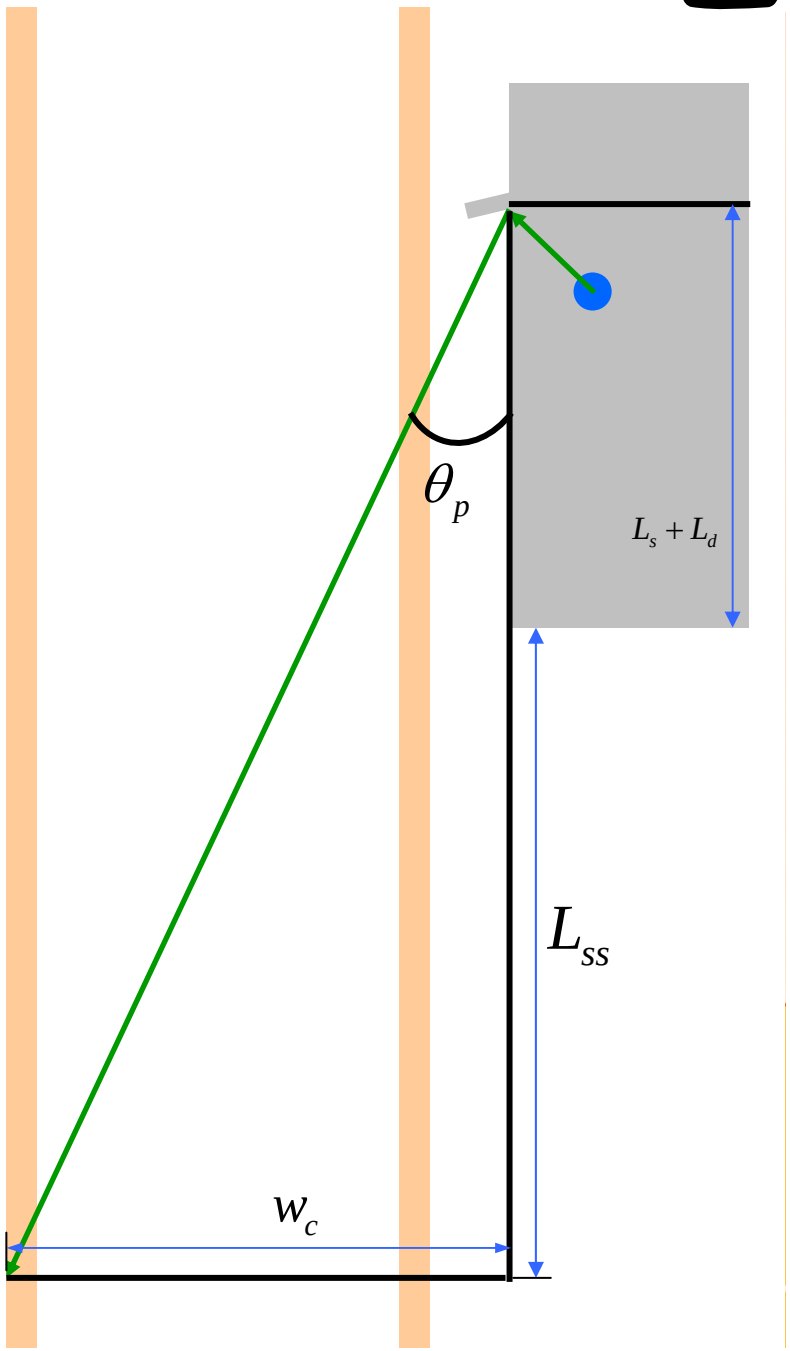
$$\theta_x \leq \frac{\theta_1}{2}$$



Step5 : Identification of Constraints

- 안전거리에 대한 제약조건

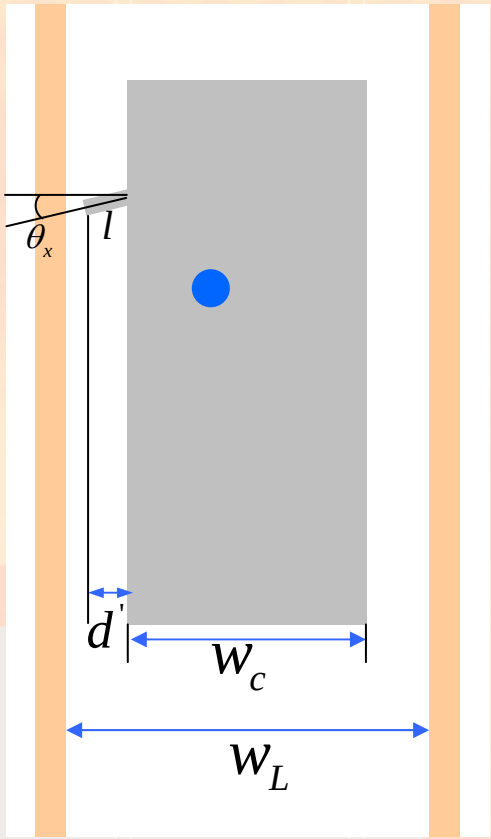
$$\theta_x \geq \frac{1}{2}\left(\theta_1 - \tan^{-1}\frac{w_c}{L_{ss}+L_s+L_d}\right)$$



Step5 : Identification of Constraints

- 도로 폭에 대한 제약조건

$$l \le \frac{(w_L - w_c)}{2\cos\theta_x}$$



Step5 : Identification of Constraints

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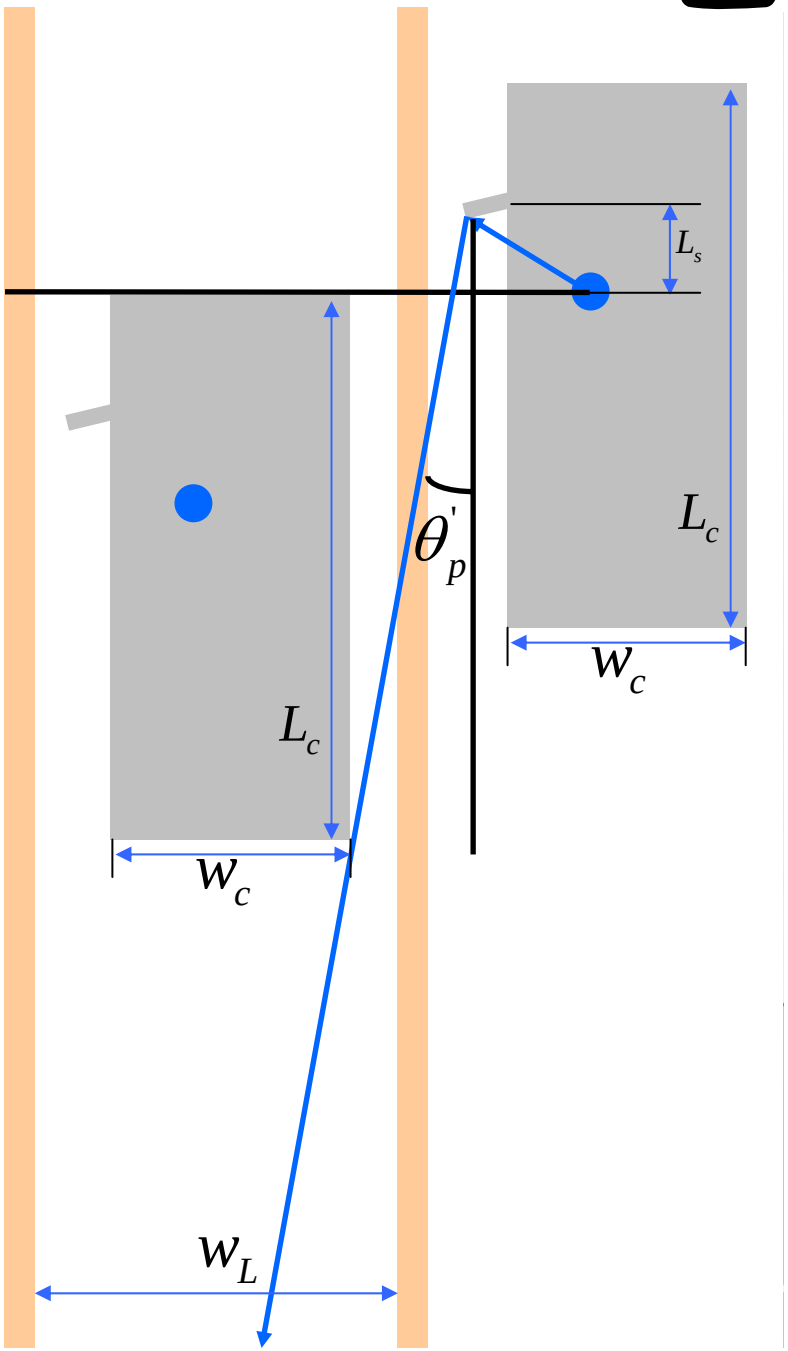
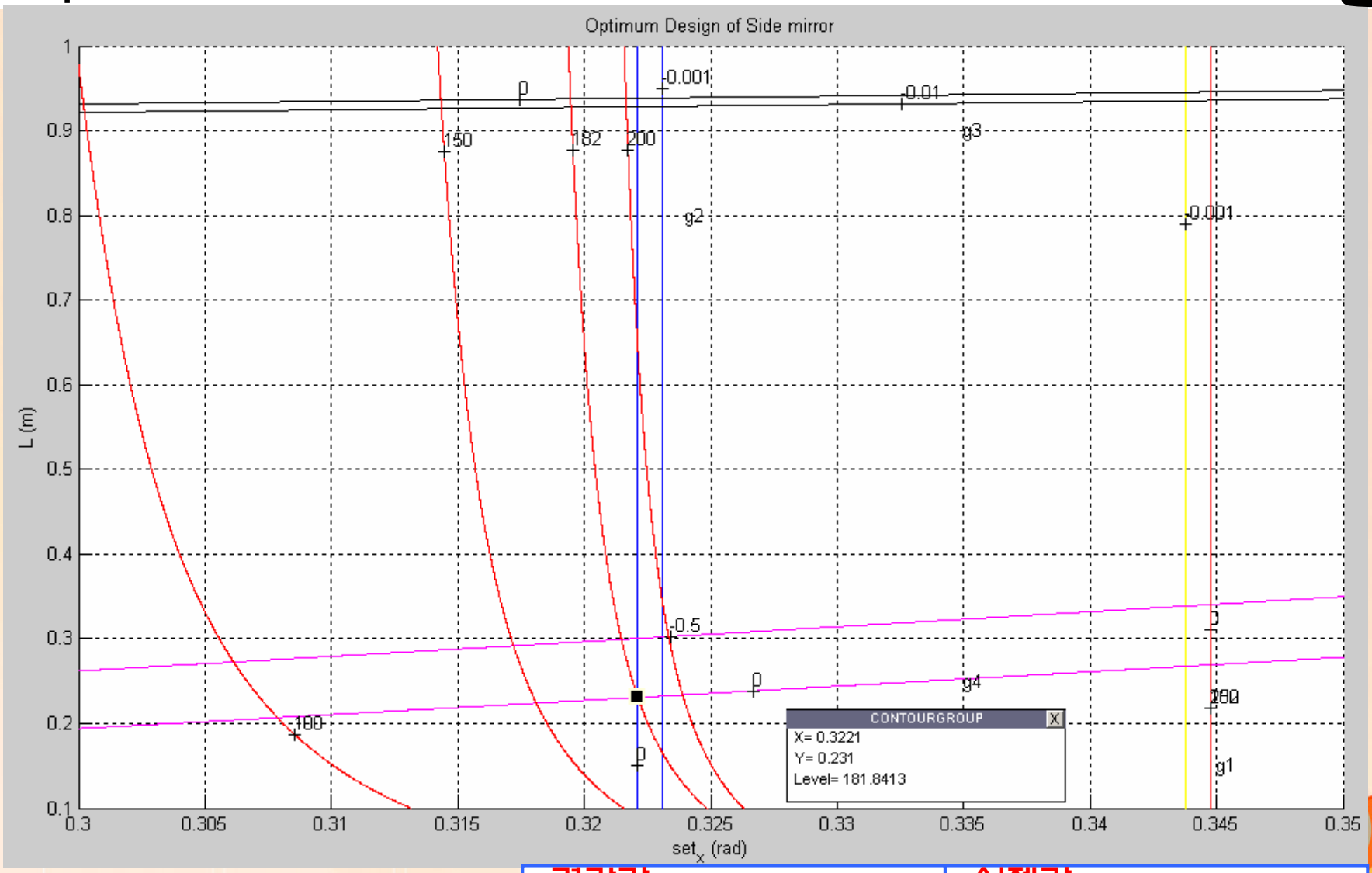
$$l \geq \frac{w_L - w_c - \tan\theta_p^{`}\left(L_s + L_c\right)}{\cos\theta_x - \sin\theta_x \tan\theta_p^{`}}$$

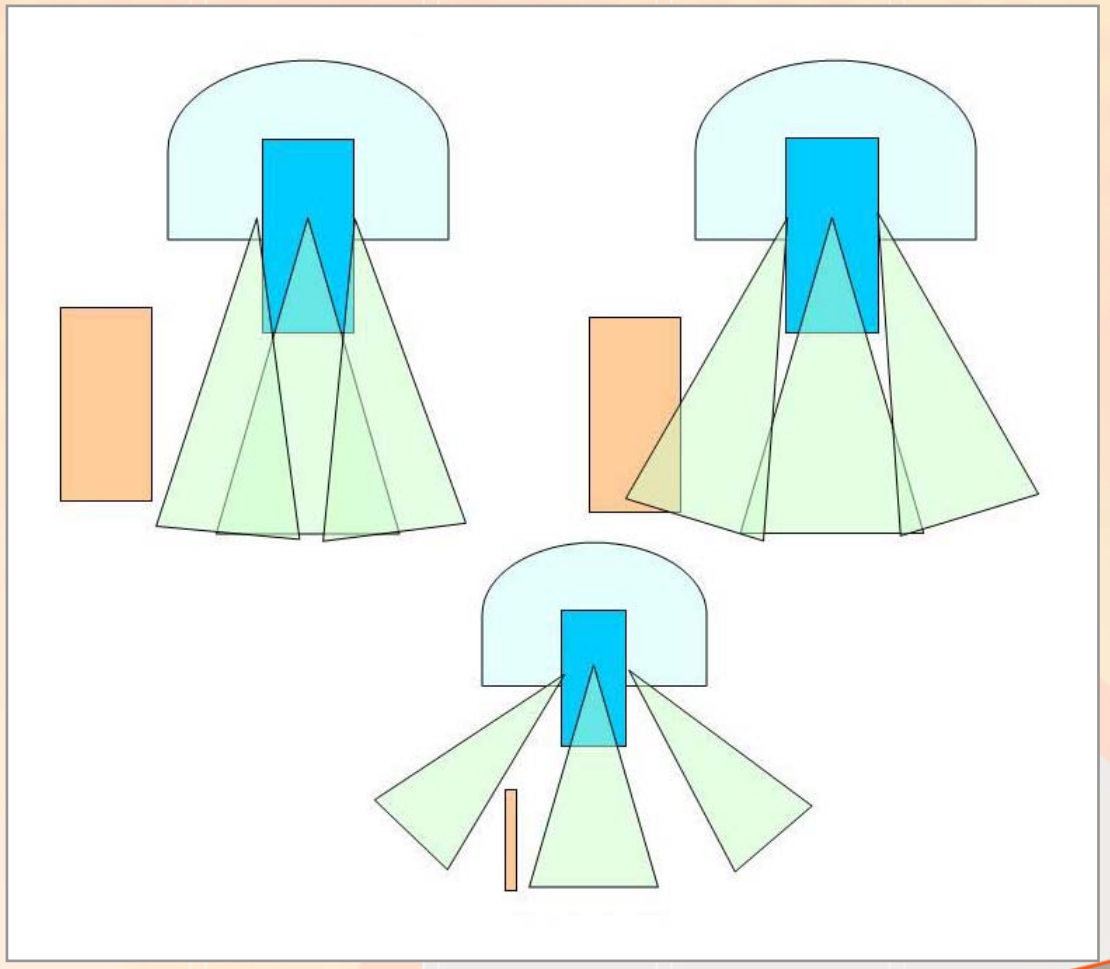


Graph



•결과값	•실제값
Set_x=0.3221 rad	Set_x= ? rad
(18.455 °)	(? °)
L=0.231 m	L=0.18 m

Graph



Graph

- 최적값에 의한 view region