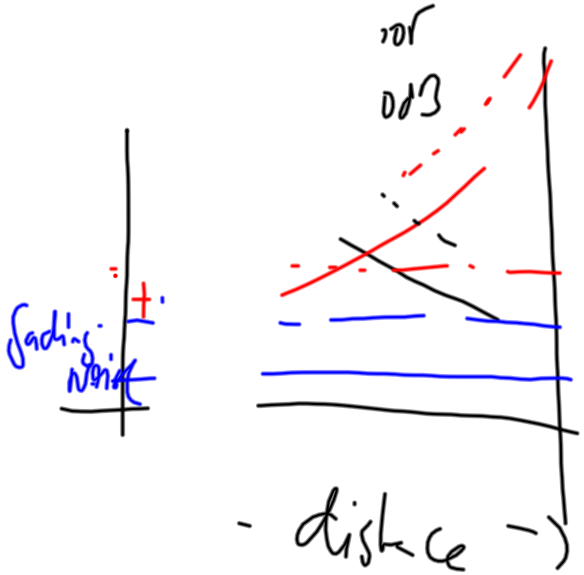
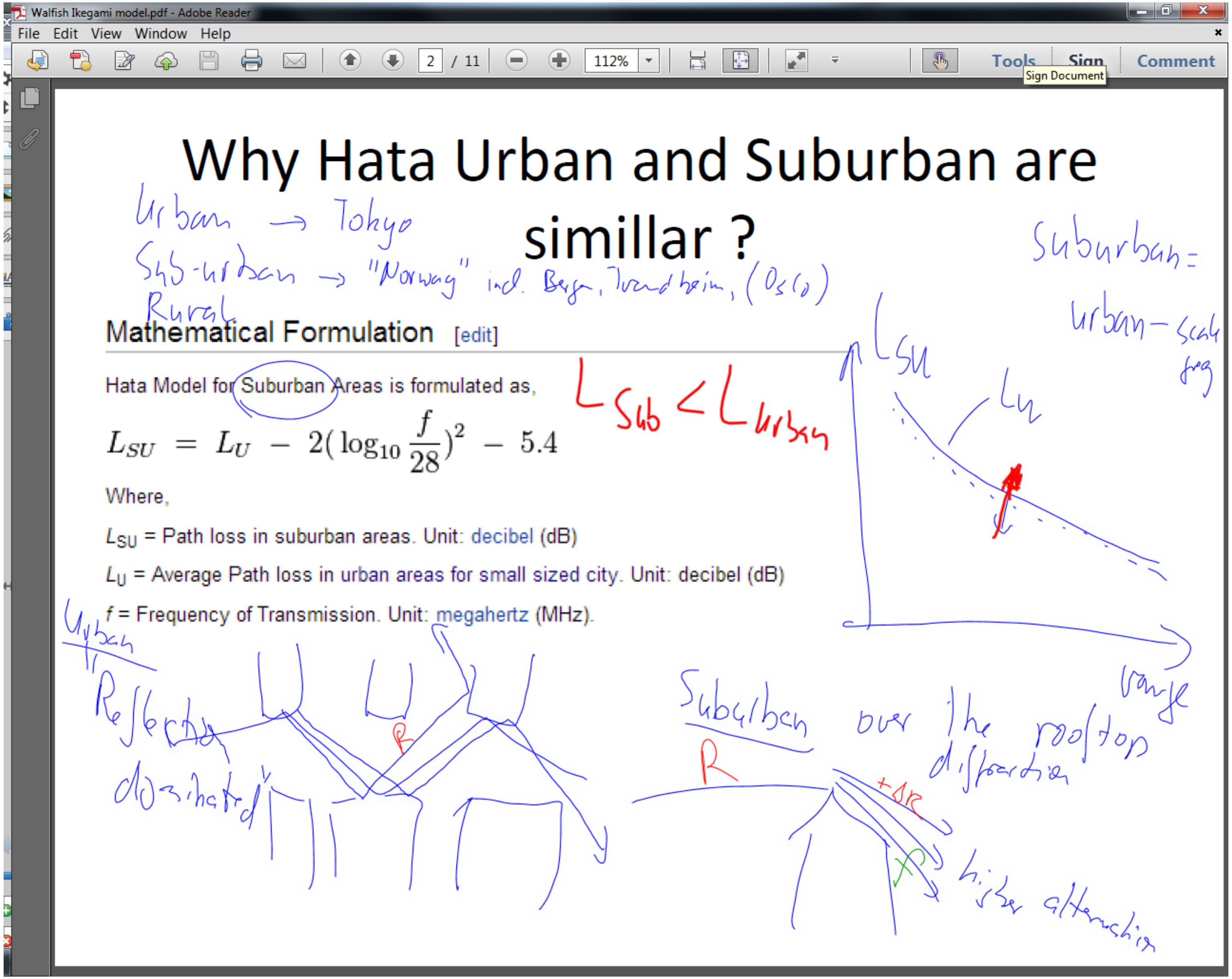
Network Parameters & Handover

<u>indoor</u> usage -30dB





Why Hata Urban and Suburban are simillar ?

Urban → Tokyo
Sub-urban → "Norway" incl. Bergen, Trondheim, (Oslo)
Rural

Suburban = urban-scale freq

Mathematical Formulation [edit]

Hata Model for Suburban Areas is formulated as,

$$L_{SU} = L_U - 2(\log_{10}\frac{f}{28})^2 - 5.4$$

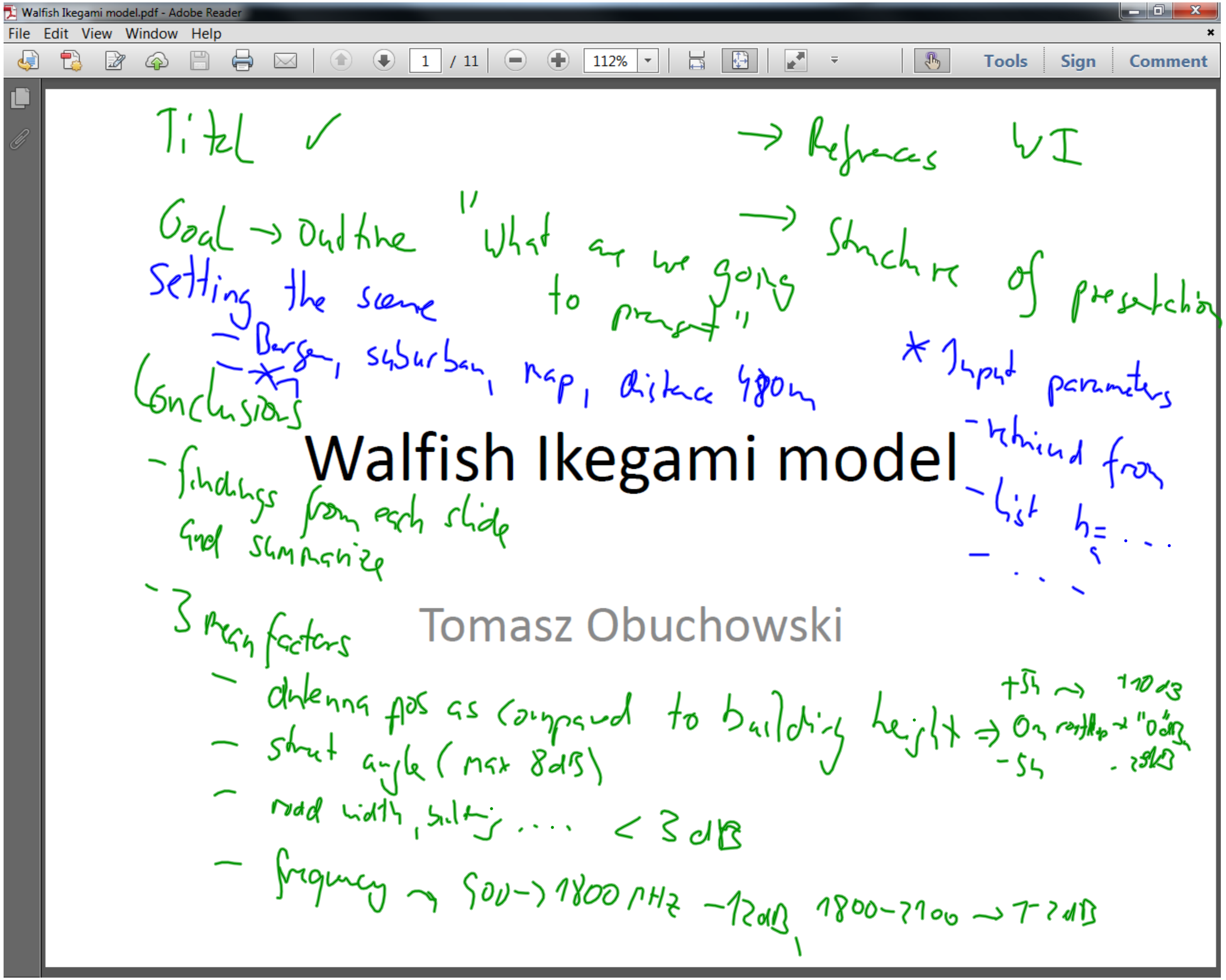
$L_{Sub} < L_{urban}$

Where,

L_{SU} = Path loss in suburban areas. Unit: decibel (dB)

L_U = Average Path loss in urban areas for small sized city. Unit: decibel (dB)

f = Frequency of Transmission. Unit: megahertz (MHz).



Walfish Ikegami model

Tomasz Obuchowski

Titel ✓

→ References WI

Goal → Outline "What are we going to present" → Structure of presentation

Setting the scene
- Bergen, suburban, map, distance 480m
- *

* Input parameters
- behind from
- dist $h_r = \dots$
- ...

Conclusions
- findings from each slide and summarize
- 3 main factors
  - antenna pos as compared to building height ⇒ +5h → 10 dB; 0h rooftop → "0 dB"; −5h → 25 dB
  - street angle (max 8dB)
  - road width, buildings .... < 3 dB
  - frequency → 900→1800 MHz −12dB, 1800−2100 → 7-2 dB

Other comments

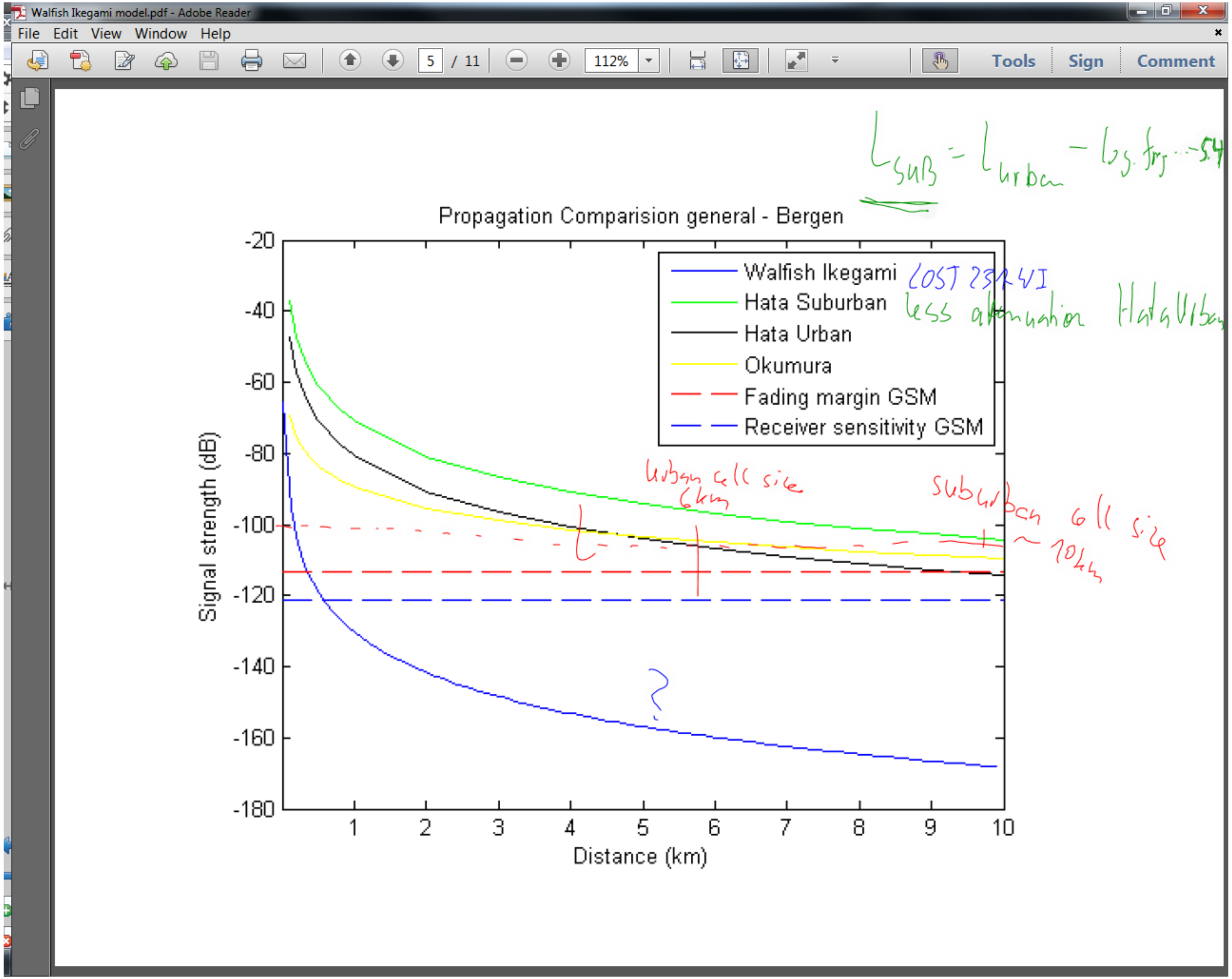
- sketch together with simulation results
  drawing
- highlight typical values

12dB

900 MHz
↓
1800

- use of science
  - 2nd source
  - be specific

	indication
small	-130dBm
big	~10dB
huge	>50m



$L_{SUB} = L_{urban} -$ log. frq ...-5.4

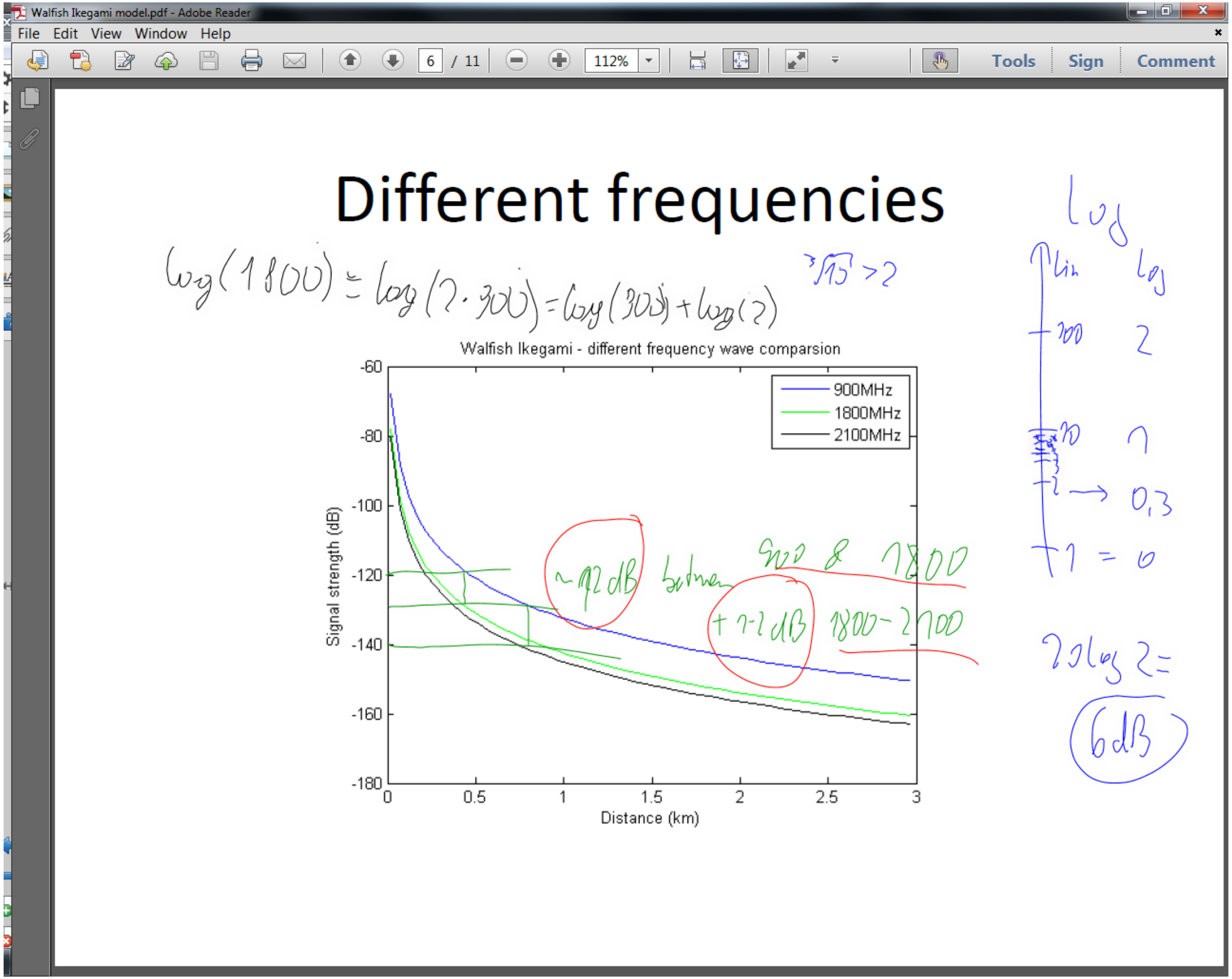
COST 231 - WI

less attenuation HataUrban

urban cell size 6km

suburban cell size ~10km

?



Different frequencies

$\log(1800) \approx \log(2 \cdot 900) = \log(900) + \log(2)$

$\sqrt[3]{15} > 2$

~12 dB between 900 & 1800

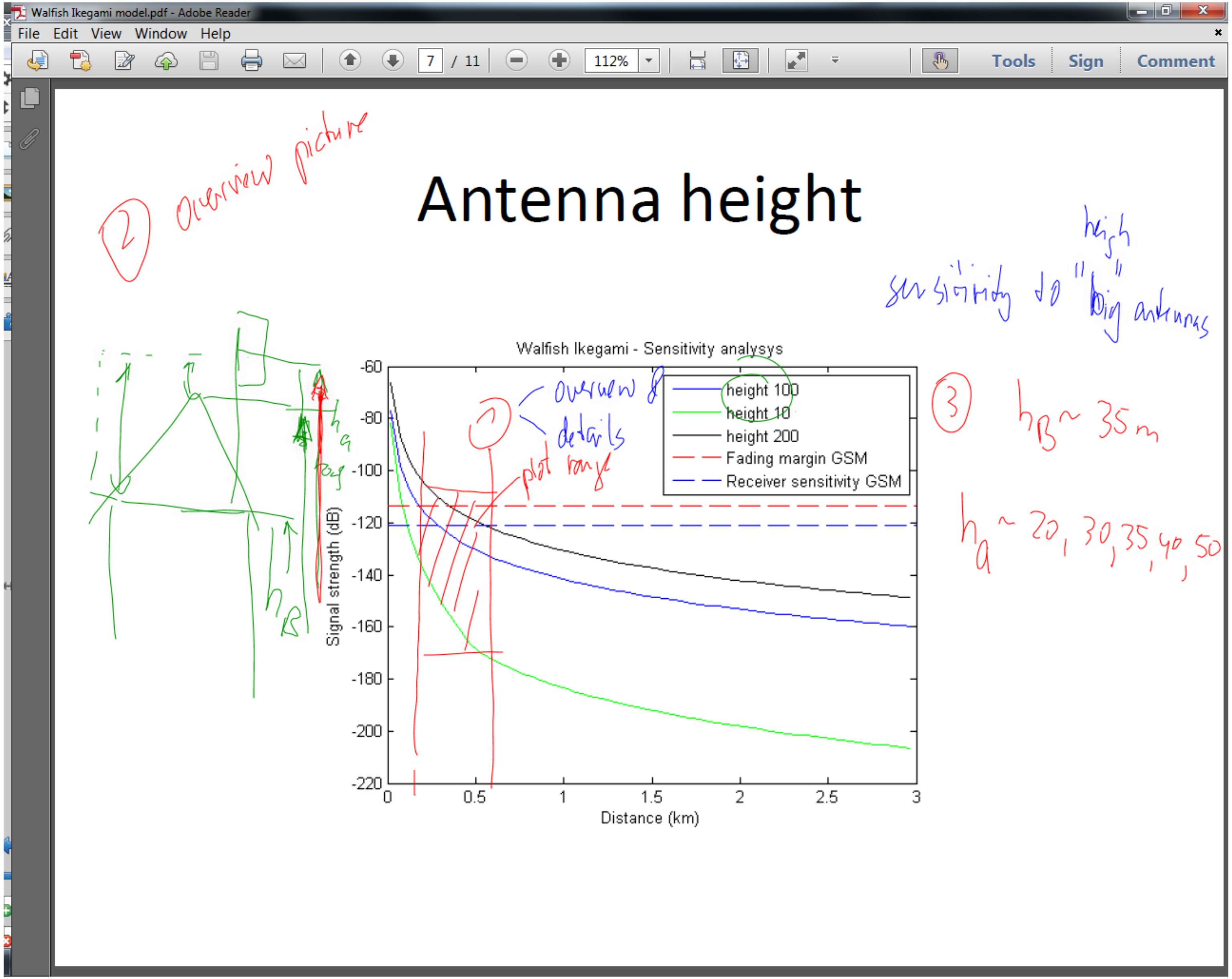
+ 1-2 dB 1800-2100

log

lin log
100 2
10 1
2 → 0,3
1 = 0

$20 \log 2 =$

6dB



Antenna height

② overview picture

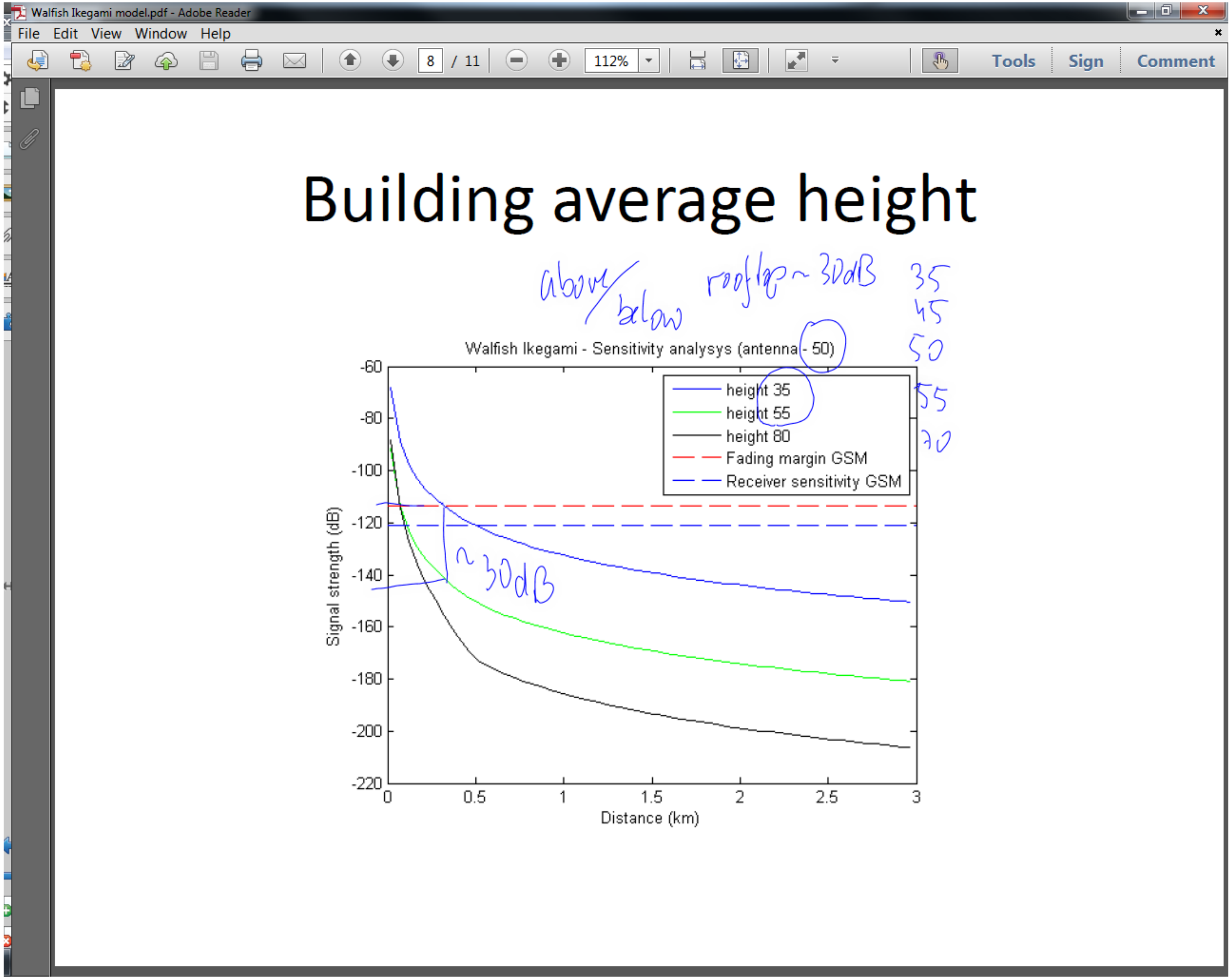
sensitivity to "~~big~~ high" antennas

① overview & details

plot range

③ $h_B \sim 35$ m

$h_a \sim 20, 30, 35, 40, 50$



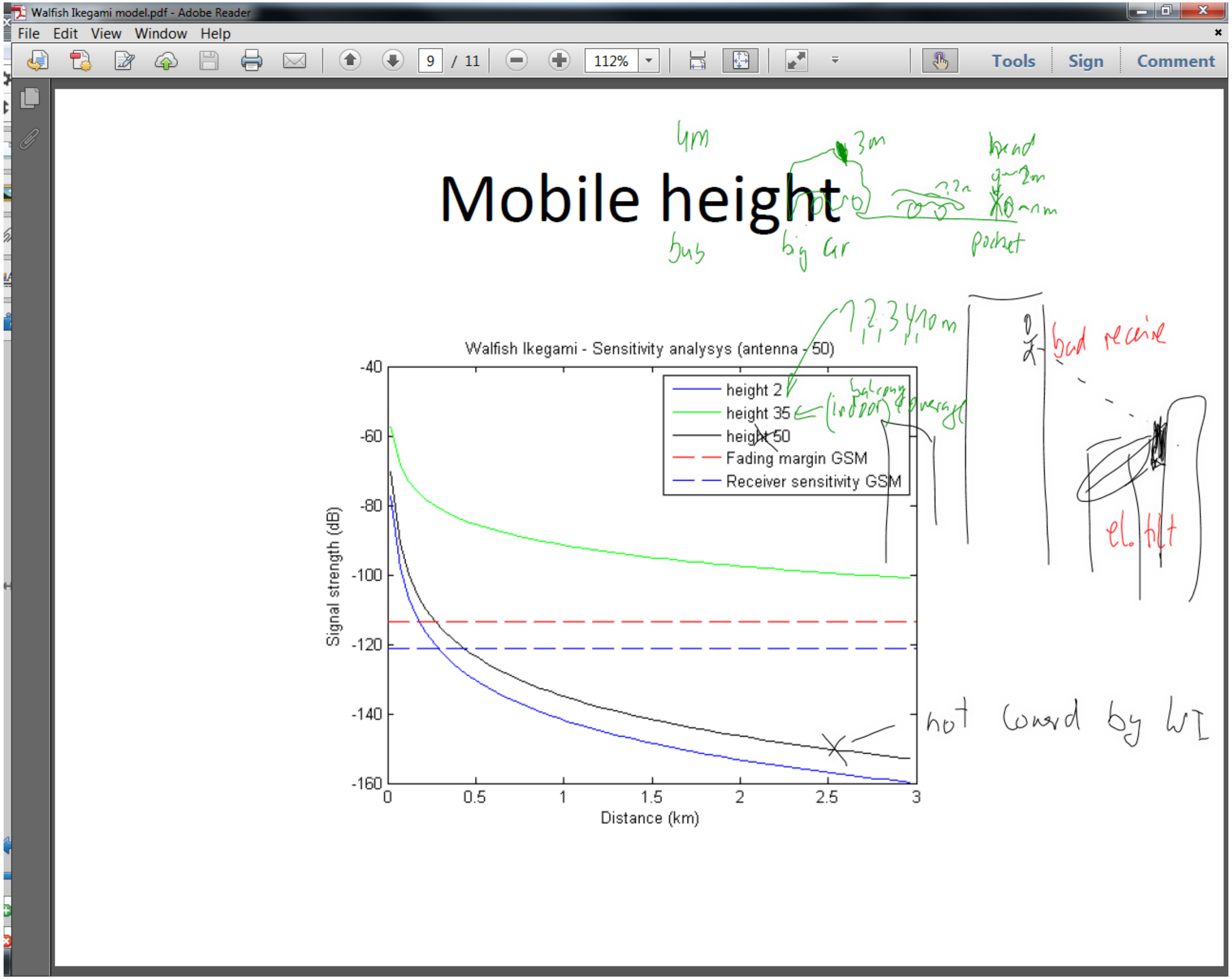
Building average height

above/below

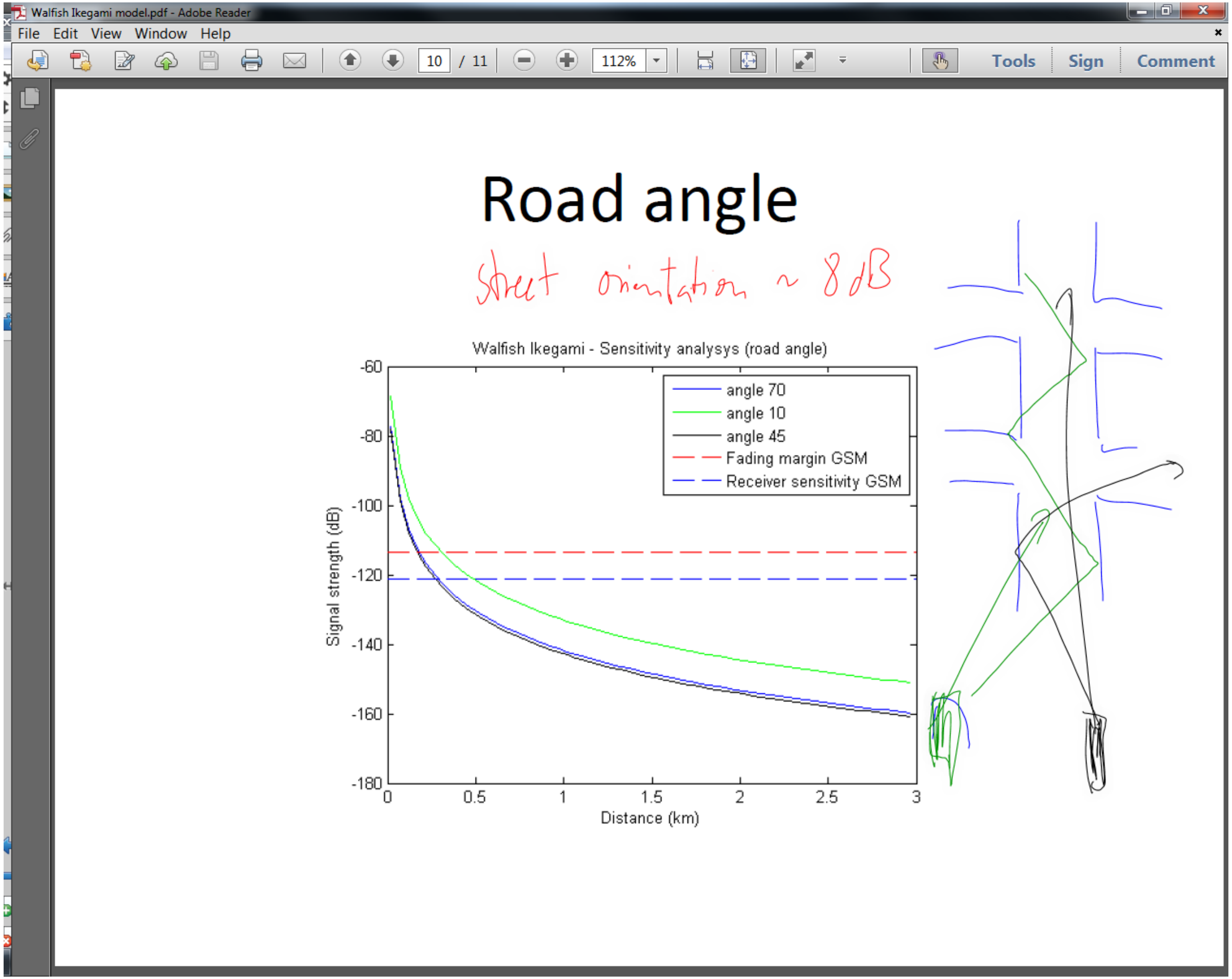
rooftop ~ 30dB

35
45
50
55
70

~30dB

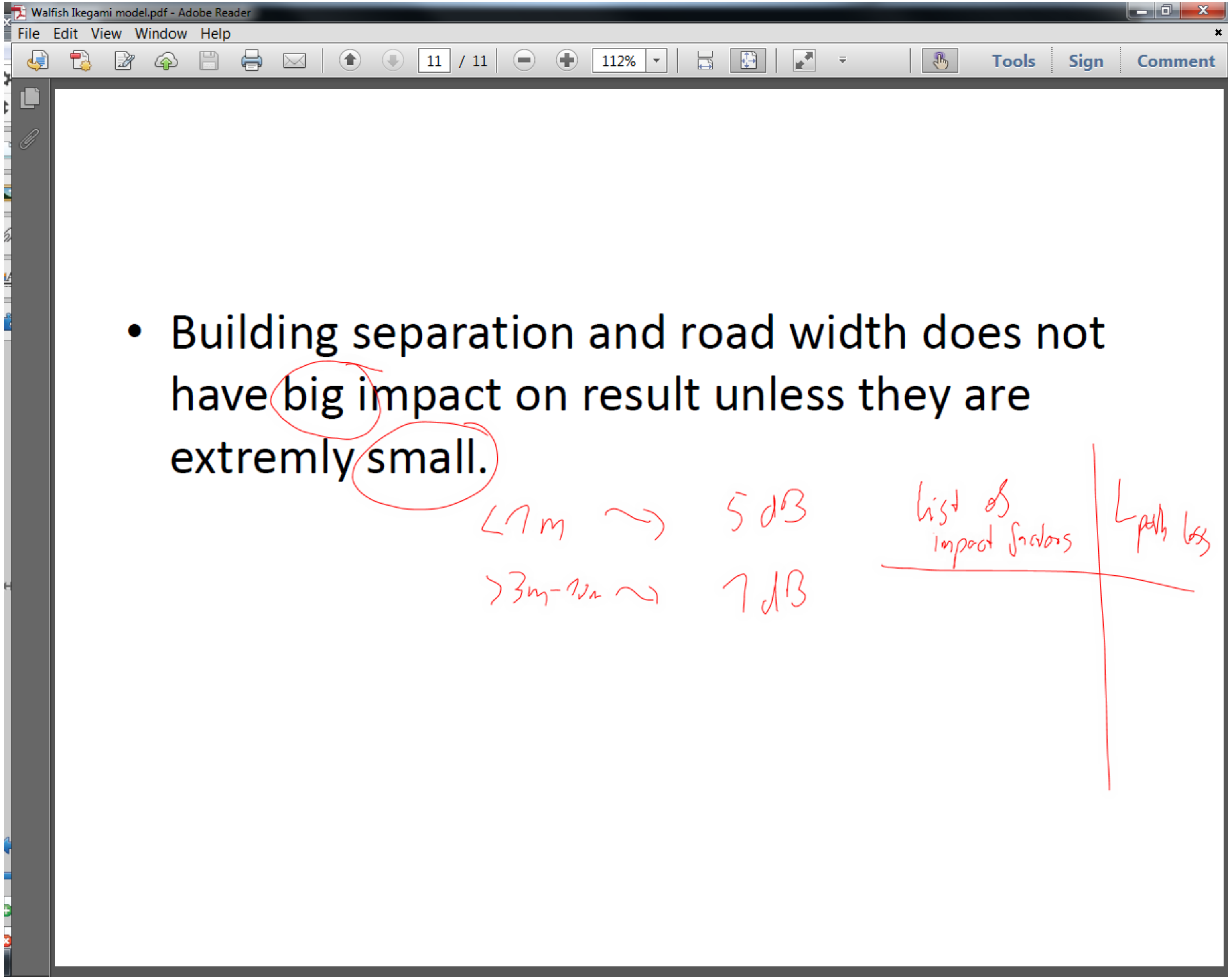


Mobile height



Road angle

Street orientation ~ 8 dB



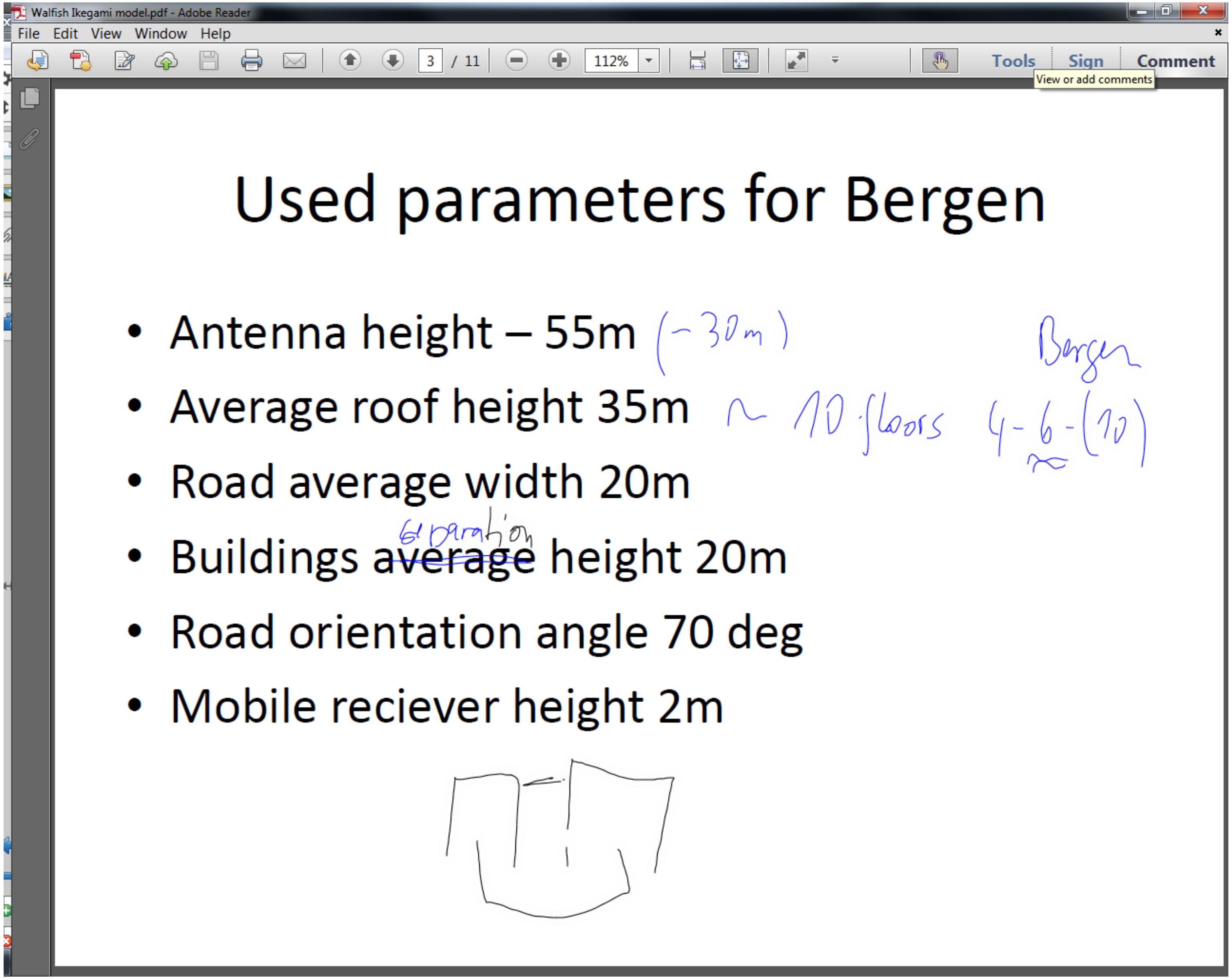
- Building separation and road width does not have big impact on result unless they are extremly small.

<7m ~> 5 dB

>3m-7m ~> 7 dB

list of impact factors

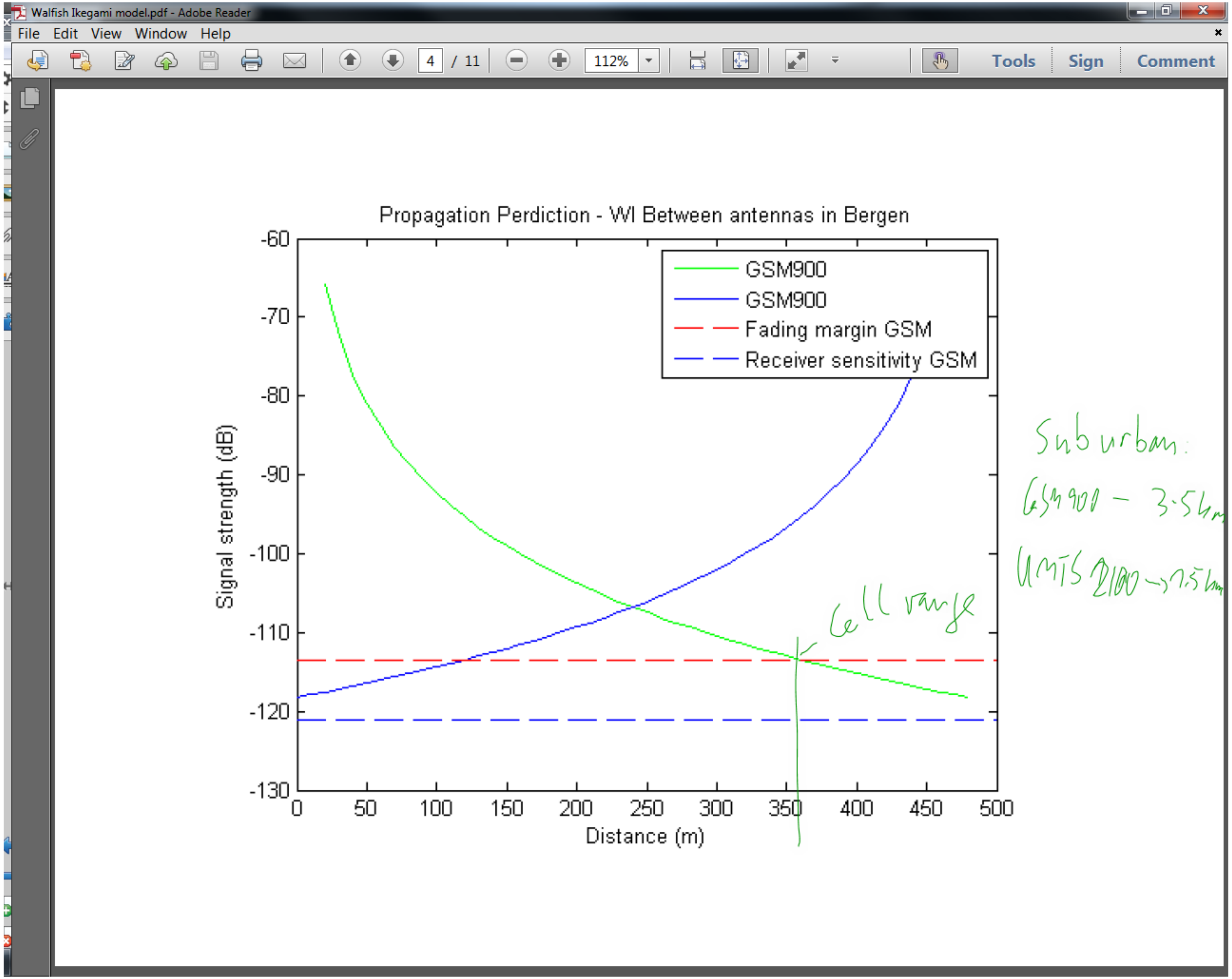
L path loss



Used parameters for Bergen

- Antenna height – 55m (~30m)
- Average roof height 35m ~ 10 floors
- Road average width 20m
- Buildings ~~average~~ separation height 20m
- Road orientation angle 70 deg
- Mobile reciever height 2m

Bergen
4-6-(10)
≈



Suburban:

GSM900 – 3.5km

UMTS 2100 → 7.5km

Challenge

Cost 231 WI verification

A

B

$h_B = 15m$

$\rightarrow L_0$

Test case

d = 1 km

f = 900 MHz

r_w = 10 m

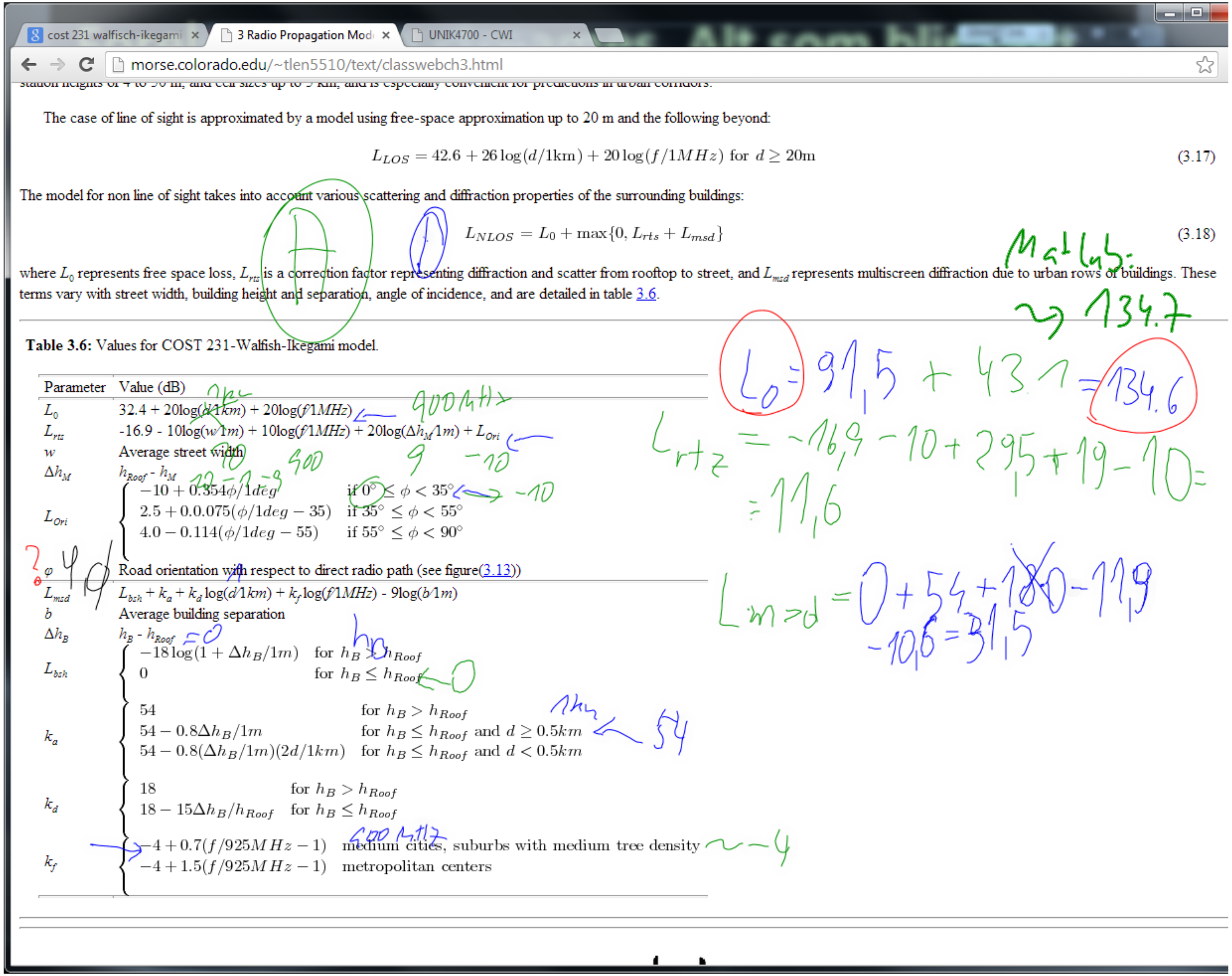
b building sep = 15 m

h_B ant. height = 10 m

mob rec height = 1 m

street angle = 0°

h_{roof} av building height = 10 m



station heights of 4 to 50 m, and cell sizes up to 5 km, and is especially convenient for predictions in urban corridors.

The case of line of sight is approximated by a model using free-space approximation up to 20 m and the following beyond:

$$L_{LOS} = 42.6 + 26\log(d/1\text{km}) + 20\log(f/1MHz) \text{ for } d \geq 20\text{m} \tag{3.17}$$

The model for non line of sight takes into account various scattering and diffraction properties of the surrounding buildings:

$$L_{NLOS} = L_0 + \max\{0, L_{rts} + L_{msd}\} \tag{3.18}$$

where L_0 represents free space loss, L_{rts} is a correction factor representing diffraction and scatter from rooftop to street, and L_{msd} represents multiscreen diffraction due to urban rows of buildings. These terms vary with street width, building height and separation, angle of incidence, and are detailed in table 3.6.

Matlab:

→ 134.7

Table 3.6: Values for COST 231-Walfisch-Ikegami model.

Parameter	Value (dB)
L_0	$32.4 + 20\log(d/1km) + 20\log(f/1MHz)$ ← 2km 900MHz
L_{rts}	$-16.9 - 10\log(w/1m) + 10\log(f/1MHz) + 20\log(\Delta h_M/1m) + L_{Ori}$ ← 20 900 9 −10
w	Average street width
Δh_M	$h_{Roof} - h_M$ 22−13=9
L_{Ori}	$\begin{cases} -10 + 0.354\phi/1deg & \text{if } 0° \leq \phi < 35° \\ 2.5 + 0.0.075(\phi/1deg - 35) & \text{if } 35° \leq \phi < 55° \\ 4.0 - 0.114(\phi/1deg - 55) & \text{if } 55° \leq \phi < 90° \end{cases}$ ↔ −10
? θ φ ψ ϕ	Road orientation with respect to direct radio path (see figure(3.13))
L_{msd}	$L_{bsh} + k_a + k_d\log(d/1km) + k_f\log(f/1MHz) - 9\log(b/1m)$
b	Average building separation
Δh_B	$h_B - h_{Roof}$ =0
L_{bsh}	$\begin{cases} -18\log(1 + \Delta h_B/1m) & \text{for } h_B > h_{Roof} \\ 0 & \text{for } h_B \leq h_{Roof} \end{cases}$ hB ← 0
k_a	$\begin{cases} 54 & \text{for } h_B > h_{Roof} \\ 54 - 0.8\Delta h_B/1m & \text{for } h_B \leq h_{Roof} \text{ and } d \geq 0.5km \\ 54 - 0.8(\Delta h_B/1m)(2d/1km) & \text{for } h_B \leq h_{Roof} \text{ and } d < 0.5km \end{cases}$ 1km ← 54
k_d	$\begin{cases} 18 & \text{for } h_B > h_{Roof} \\ 18 - 15\Delta h_B/h_{Roof} & \text{for } h_B \leq h_{Roof} \end{cases}$
k_f	→ $\begin{cases} -4 + 0.7(f/925MHz - 1) & \text{medium cities, suburbs with medium tree density} \\ -4 + 1.5(f/925MHz - 1) & \text{metropolitan centers} \end{cases}$ 900 MHz ~ −4

$\boxed{L_0 =}\ 91,5 + 43,1 = \boxed{134.6}$

$L_{rtz} = -16,9 - 10 + 29,5 + 19 - 10 =$
$= 11,6$

$L_{m>d} = 0 + 54 + 1\cancel{8}0 - 11,9$
$- 10,6 = 31,5$

Next lecture

- update presentation   use our parameters
  Hata ...
  $d = 300 \ldots 3\ km$
- hand calculate B
- "UNIK" building /indoor