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BLUE TEAM

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RAINFALLS ESTIMATION

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Introduction

This report is presenting the work that the blue team has realized on the precipitation data to calculate different rainfall event considering the return period and the duration of the event.

I. Data and formula

We have used these given formula (*figure 1*) that have been set up for Incheon area considering the following rainfall stations (*figure 2*):

Return Period	Rainfall intensity formula	Return Period	Rainfall intensity formula
2 years	$\frac{655.6}{t^{0.6278} + 3.40}$	**30 years**	$\frac{2369.8}{t^{0.6955} + 12.02}$
3 years	$\frac{788.1}{t^{0.6299} + 3.81}$	**50 years**	$\frac{2989.3}{t^{0.7105} + 15.23}$
5 years	$\frac{1042.1}{t^{0.6466} + 5.12}$	**70 years**	$\frac{3572.9}{t^{0.7250} + 18.36}$
10 years	$\frac{1419.4}{t^{0.6626} + 6.99}$	**80 years**	$\frac{3858.0}{t^{0.7313} + 19.91}$
20 years	$\frac{1934.1}{t^{0.6905} + 9.67}$	**100 years**	$\frac{4320.7}{t^{0.7413} + 21.82}$

Figure 1 : *table of the intensity formula for different return period (t is the duration of the rainfall event in minutes and the intensity is in mm/h)*

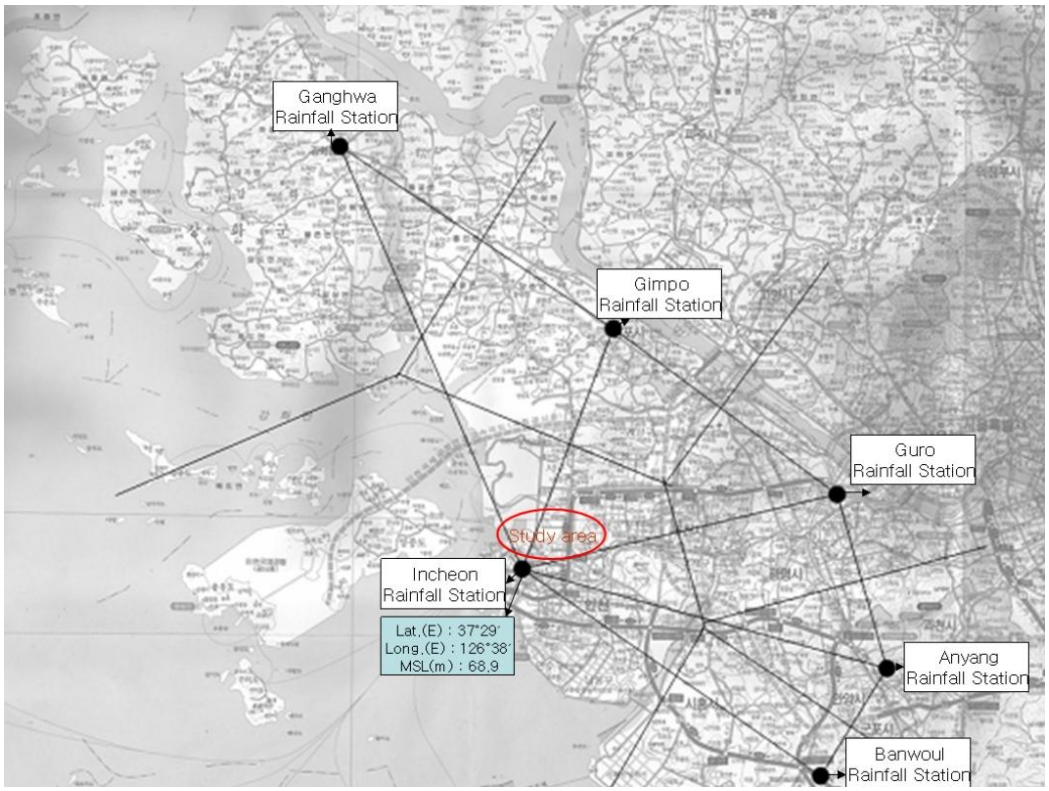

Figure 2 : *location of the rainfall station used to build up the formula*

44 years of rainfall data have been used to build the formula (from 1961~2004) with the "Method of Probability Weighted Moment", which uses 3 distributions: General Extreme Value (GEV), Gumbel (GUM) and Log-Normal 2 (LN2), and finally the GEV distribution is used for Incheon University Formula.

We also had the rainfall event of the 4th August 1997 from 4:00 a.m. to 6:00 p.m. (*figure 3*):

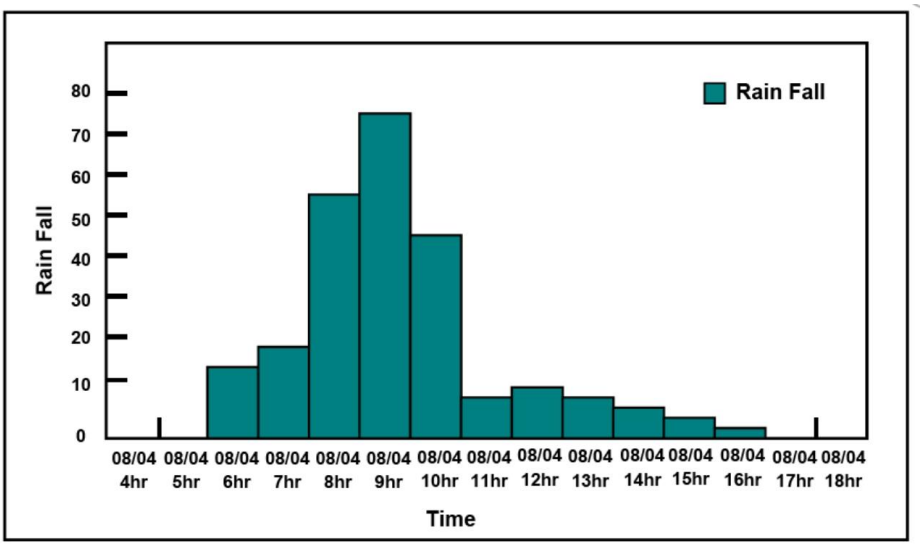

Figure 3 : *hyetograph of the rainfall in mm for each hour of the 4th August 1997 from 4:00 a.m. to 6:00 p.m.*

II. Rainfalls estimation

We would like to estimate the precipitations for different return period of the event. We can use the formula above to calculate the intensity *I* (in mm/h) for a rainfall event duration time *t* (in min).

Then, we multiply the *I* that we have found with the duration *t* (in h!) used for the calculation and we obtain the total rainfall *P* (in mm) for the duration *t* of the event.

Finally, we want to split this rainfall for each hour of the whole event. To achieve it, we consider the hyetograph of 1997, because this rainfall event is the worst of the previous 40 years and it fits well with our model. We have calculated the percentage of the total rainfall that has fall during the first hour of the event, then during the second hour and so on and we obtain the following percentages (*figure 4*):

Time	Percentage of rainfall
4:00 AM	0
5:00 AM	0
6:00 AM	4.958677686
7:00 AM	7.024793388
8:00 AM	22.72727273
9:00 AM	30.99173554
10:00 AM	18.59504132
11:00 AM	3.305785124
12:00 PM	3.719008264
1:00 PM	3.305785124
2:00 PM	2.892561983
3:00 PM	2.066115702
4:00 PM	0.41322314
5:00 PM	0
6:00 PM	0

Figure 4 : *percentage of rainfall for each hour of the event of 1997*

For example, for a duration time of 12 hours and a return period of 80 years, we have the following intensity:

$$I = \frac{3858.0}{(12*60)^{0.7313} + 19.91} = 27 \text{ mm.h}^{-1}$$

Then we have the following total rainfall on the 12 hours:

$$P = t * I = 27 * 12 = 324 \text{ mm}$$

We split it with the percentage shown in the table above and we obtain the following hyetograph (*figure 5*):

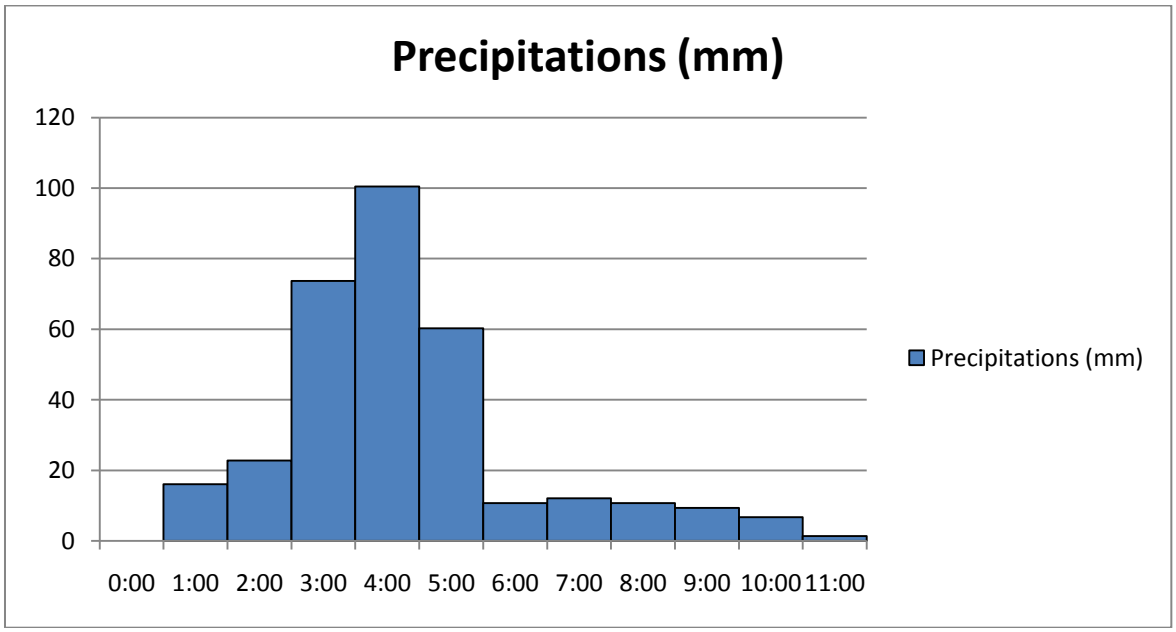

Figure 5 : *precipitations for each hour of a 12 hours event with a return period of 80 years*

However, the 1997 rainfall event is considered like having an 80 years return period but does not look like this hyetograph. The simple explanation is that the return period has been calculated probably only on the 3 peak hours for the 1997 event, which means that we should use the intensity calculated for 3 hours of rainfall event duration and then transfer the peak that we obtain on the 12 hours calculation and see which return period corresponds to the peak.

For example, the 1997 event corresponds to a 20 years return period with an event duration of 12 hours (*figure 6*):

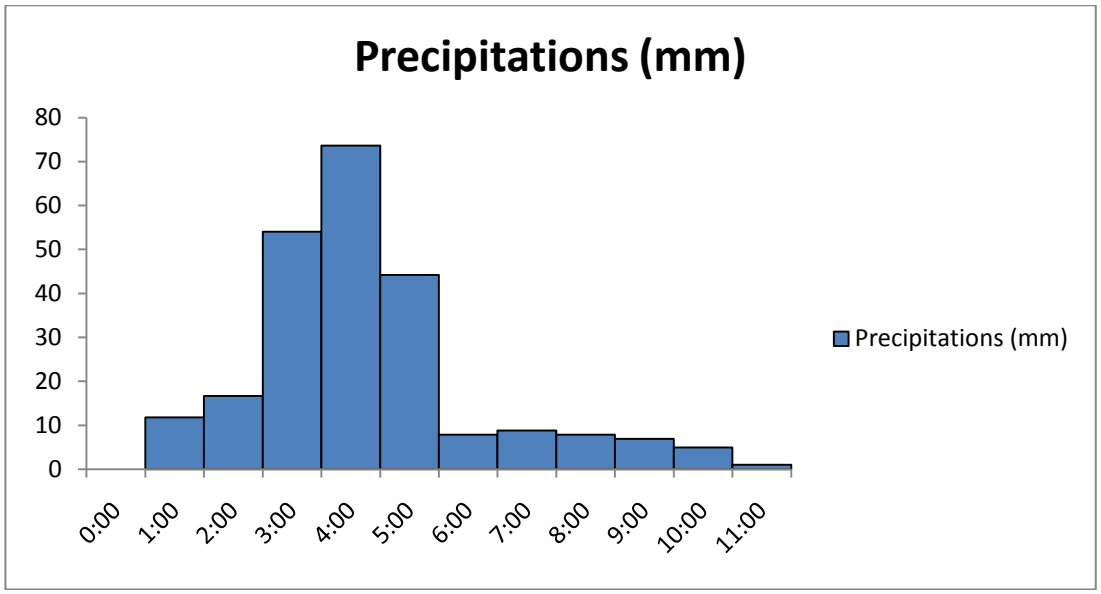

Figure 6 : *precipitations for each hour of a 12 hours event with a return period of 80 years, we can see that this event corresponds to the one of 1997*

Conclusion

The formula established by the University of Incheon have allowed us to build different rainfall events corresponding to different return periods. These data show that the flooding event is due more to the intensity of the peak rainfalls than to the duration of the event.

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