

## **Regionalization Of Intensity – Duration – Frequency (IDF) curves in Albania**

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### ▪ **ABSTRACT**

The scope of this study is the creation of the IDF curves of the zones, in which continuous rain measurements are missing, except of 24 – hour measurement through pluviometer.

So, there are elaborated the tables of rain' intensities in the meteorological stations from the continuous measurements through pluviographs.

Based on the values of the rain' intensities of different duration and different return periods from these rain gauges the IDF curves of these urban areas were established.

Based on the climate zone of the areas, the territory of Albania was regionalized, in order that each of these regions could be presented by IDF curve(s) from the up mentioned data.

Finally, IDF curves are established for the urban or rural areas (or different zones), in which only pluviometric data exist.

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**Keywords:** *IDF curves, rain intensity, regionalization,*

### ▪ **GENERAL**

Important components of the civil engineering works are the surface water drainage and discharge systems or storm water drainage and discharge systems.

The storm water data of the building region are needed for these systems design. These data are used in the in the design formulas or software in order to achieve the expected results and parameters in water systems design.

The data achieved from the curves of intensity, duration and frequency of the rainfall are a part of all the data that can be achieved from the storm water precipitations in order to be used in the design of the up mentioned systems. In these curves are presented three important parameters of the rainfall or precipitation, such as rainfall intensity, duration and frequency. These parameters are very important and sometimes crucial in the works design. The up mentioned curves that can give us the data about intensity, duration and frequency of the rainfall are called IDF curves.

### ▪ **IDF CURVES ESTABLISHMENTS**

At the beginning there were identified the meteorological stations (from now MS) equipped with pluviograph apparatus (blue points), which have functioned since 25 years ago. From these pluviograph are taken the data of the maximal rainfall at different durations and frequencies. These MS are showed in the map of Albania in the Figure no. 1.

In the same map are shown the meteorological stations equipped only with pluviometers (red points), which have functioned almost in the same period as the up

mentioned pluviographs. The data of 24 hours rainfall at a return period of 2 years are provided from these pluviometers and used later in the IDF curves for these pluviometers.

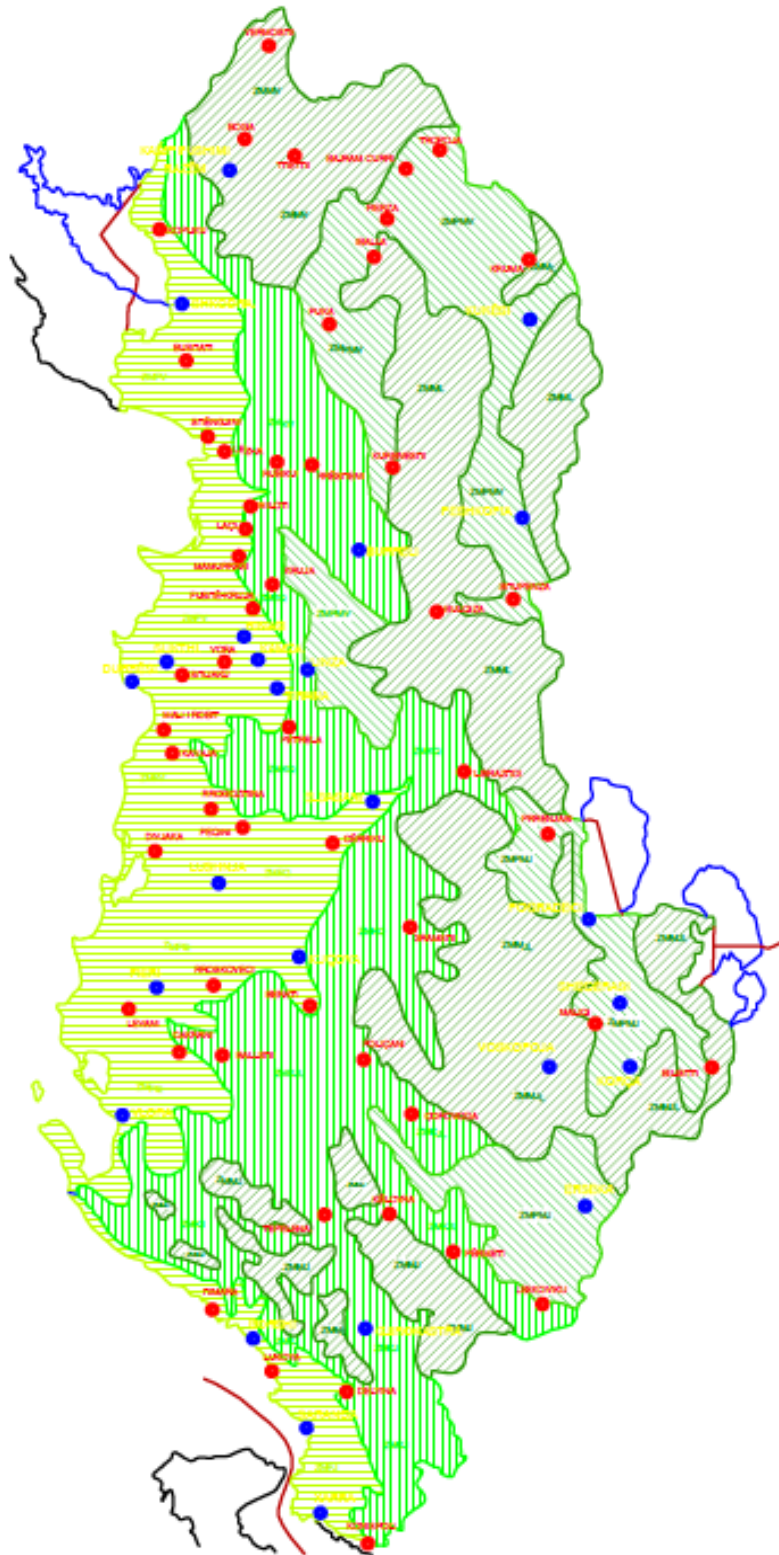


Figure 1 Climate zone map of Albania including pluviograph and pluviometer stations

The data of maximal rainfall from the IHM bulletin of 1985 [1] are used to graph the IDF curves of different stations. The data of this bulletin are provided from the direct measures of the rainfall from the pluviograph apparatus in these stations.

The data of this bulletin [1] presents the maximal rainfall values at different return periods (2, 5, 10, 20, 50 and 100 years) and different durations (such as 10 min, 20 min, 30 min, 1 hour, 2 hours, 6 hours, 12 hours and 24 hours). While the data from pluviometers present the data measured not continuously but in discrete periods such as once in 24 hours. We've chosen to use for the IDF curves generation the data at return period of 2 years and 24 hours duration.

The intensity values of each period and duration is needed for the IDF curves. So, first of all are calculated the intensities for each frequency (2, 5, 10, 20, 50 and 100 years) and each duration (such as 10 min, 20 min, 30 min, 1 hour, 2 hours, 6 hours, 12 hours and 24 hours) for some of the pluviographs data. Based on these values are generated (or graphed) the IDF curves using proper software. Below are presented IDF curves of a station with pluviograph in graphical and tabular way (Figure 2, Table 1):

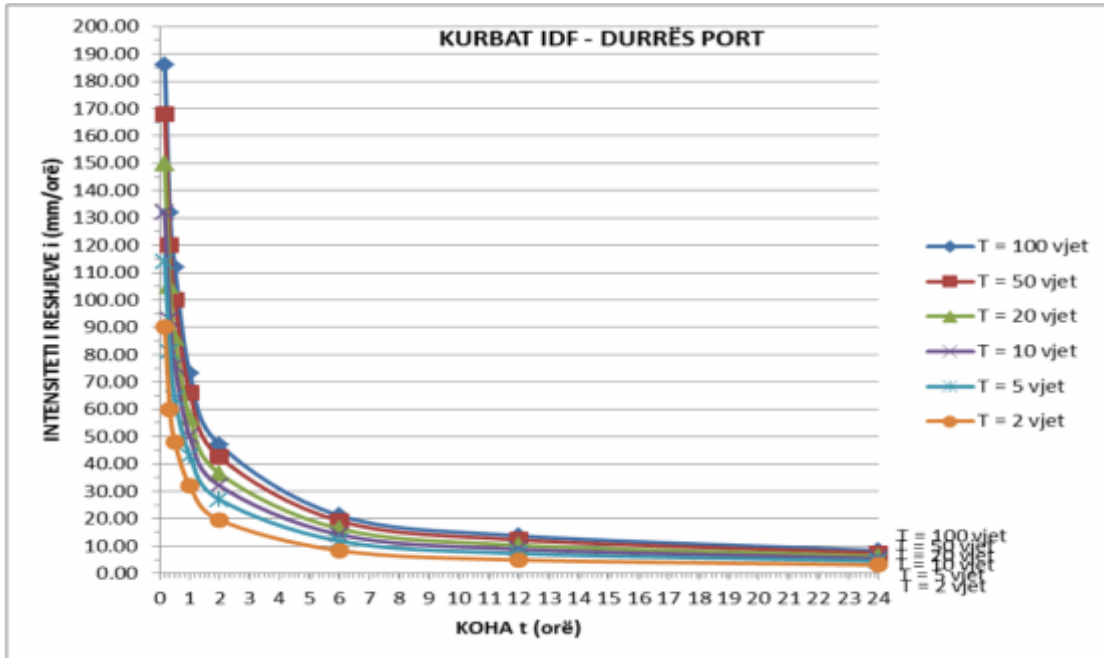


Figure 2. The graphics of IDF curves of Durrës Port Station

Table 1. The table of IDF curves of Durrës Port Station

STATION	Rainfall Duration [hours]	Return Period [years]					
		100	50	20	10	5	2
		X [mm]	X [mm]	X [mm]	X [mm]	X [mm]	X [mm]
DURRËS PORT	24	8.29	7.42	6.29	5.42	4.50	3.08
	12	13.75	12.25	10.33	8.83	7.25	4.92
	6	21.17	19.17	16.33	14.17	11.83	8.33
	2	47.00	42.50	36.50	32.00	27.00	19.50
	1	73.00	66.00	57.00	50.00	43.00	32.00
	0.50 (30 min)	112.00	100.00	86.00	76.00	64.00	48.00
	0.33 (20 min)	132.01	120.01	105.01	93.01	81.01	60.01
	0.1667 (10 min)	185.96	167.97	149.97	131.97	113.98	89.98

It can be seen from the bulletin [1] that there are few stations equipped with pluviographs in Albania. This lack of the proper measure tools can bring into non exact design parameters used in the storm water drainage and discharge systems in the public and civil works. This improper design can cause the low maintenance and malfunction of such works.

This can happen because the measures from the pluviometers are not measured continuously but in discrete periods, such as once in 24 hours, which is not enough for the function and the safety of the public works.

So, as it is mentioned, it is needed to provide IDF curves for all the regions and zones in Albania, even for the zones that have poor or no recorded data.

There are or exist too many methods or criteria for transferring, regionalizing or turning the point data into spatial data. But, it is needed to have many physical, geological and hydrological data in order to have a full and proper analogy between the point of full data and the points we need to transfer or to find the IDF curves. In this work we have simplified this criterion only in the climate zones criteria. We have established IDF curves for some stations with pluviometers based on this criterion. The basic data for these curves are provided by IDF curves of the pluviograph station, that is in the same climate zone and also in the same region or district with the pluviometer station. The distance between two stations is chosen as a criterion in order to have a closed analogy of the territory between them. So, there are established IDF curves of the pluviometer stations (with 24 hours and 2 years rainfall data), based on the criteria of the same climate sub-region (i.e. Mediterranean mountainous climate zone of North Albania or Mediterranean mountainous climate zone of South Albania).

There are established IDF curves without intensity units (on 24 hours and 2 years frequency basis) based on the IDF curves of the pluviograph stations. After that, we have established IDF curves for each pluviometer station multiplying the value of IDF curves without intensity units with the 24 hour duration and 2 years frequency rainfall data of these pluviometer stations. Below are presented IDF curves (without intensity units) of a station with pluviograph in graphical and tabular way (Figure 3, Table 2):

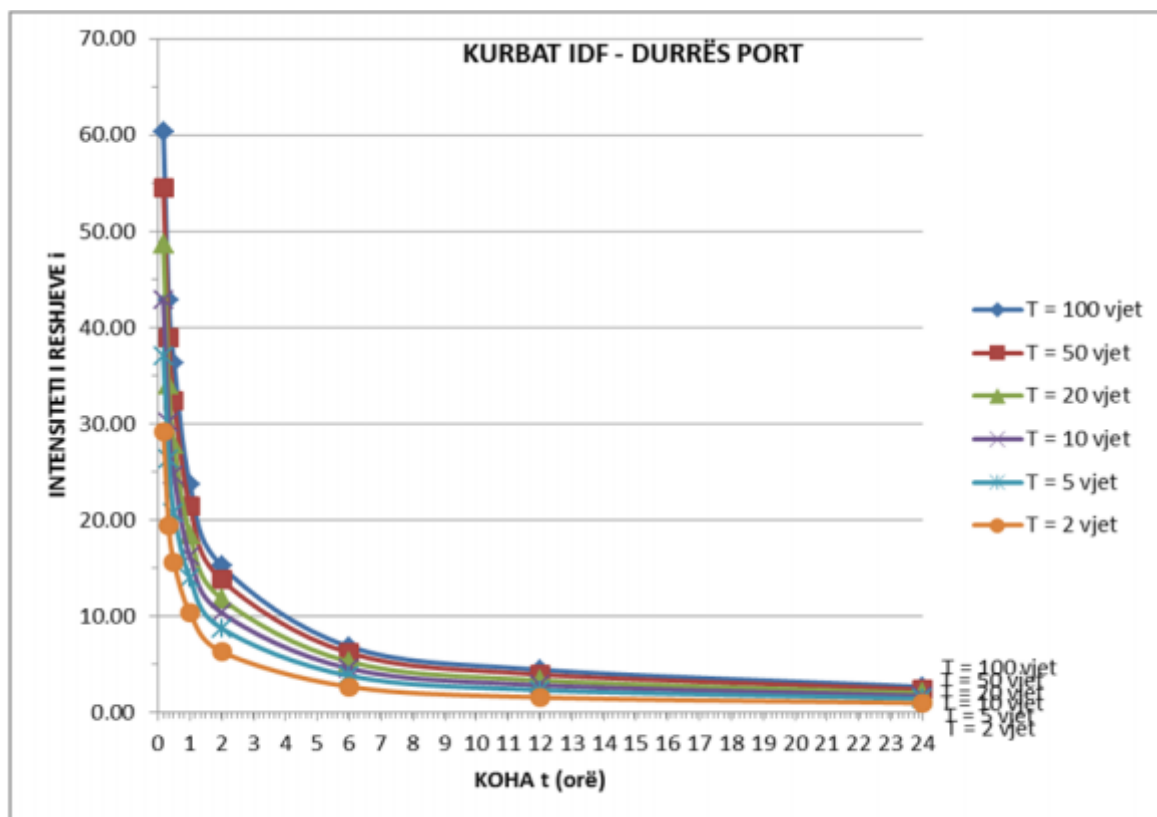


Figure 3 The graphics of IDF curves without intensity units of Durrës Port Station

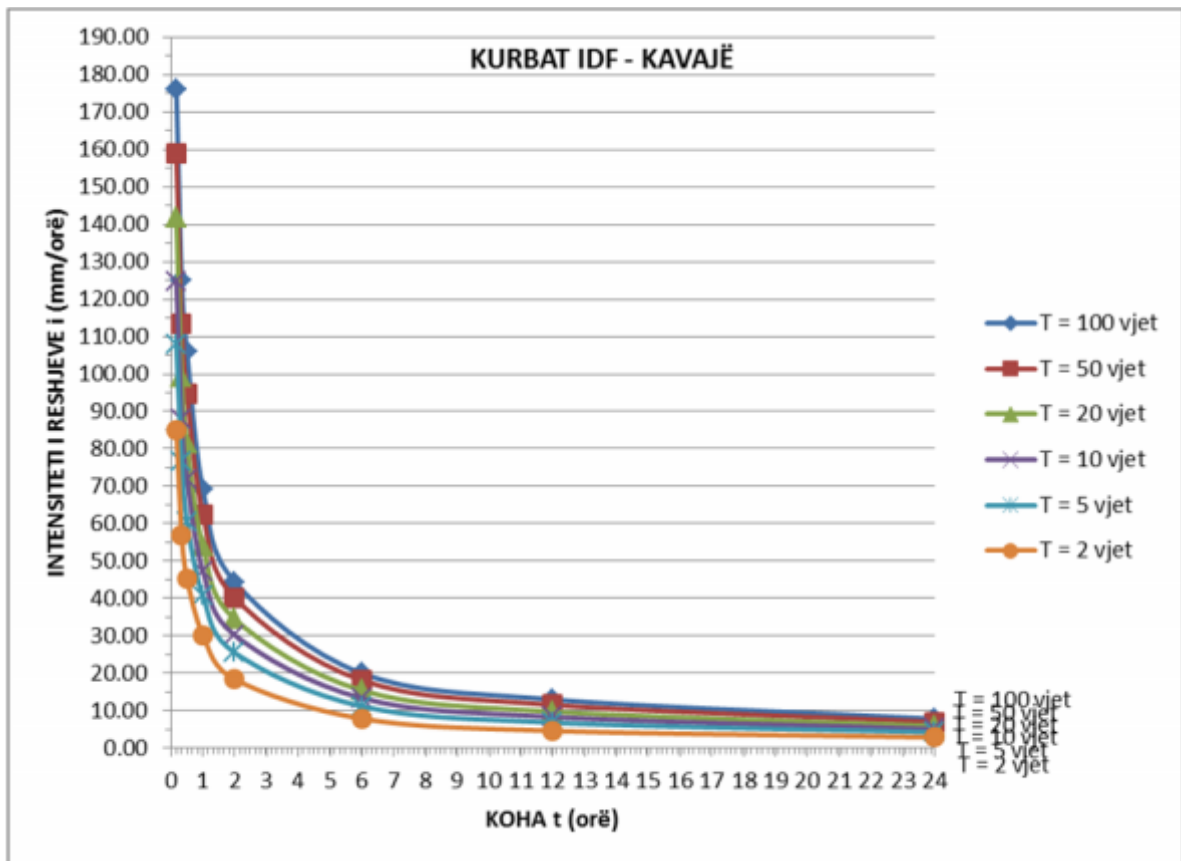
Table 2 The table of IDF curves without intensity units of Durrës Port Station

STATION	Rainfall Duration [hours]	Return Period [years]					
		100	50	20	10	5	2
		X	X	X	X	X	X
DURRËS PORT	24	2.69	2.41	2.04	1.76	1.46	1.00
	12	4.46	3.97	3.35	2.86	2.35	1.59
	6	6.86	6.22	5.30	4.59	3.84	2.70
	2	15.24	13.78	11.84	10.38	8.76	6.32
	1	23.68	21.41	18.49	16.22	13.95	10.38
	0.50 (30 min)	36.32	32.43	27.89	24.65	20.76	15.57
	0.33 (20 min)	42.82	38.92	34.06	30.17	26.27	19.46
	0.1667 (10 min)	60.31	54.48	48.64	42.80	36.97	29.18

Below is given the pluviograph station (from its data are established IDF curves) and the pluviometer station correspondent to the above station (these stations are in the same climate sub-region).

Pluviograph Station	Pluviometer Station
DURRËS	KAVAJË

Below are presented IDF curves, generated for the pluviometer station in graphical and tabular way (Figure 4, Table 3):



**Figure 4** The graphics of IDF curves generated for Kavaja Station

**Table 3** The table of IDF curves generated for Kavaja Station

STATION	Rainfall Duration [hours]	Return Period [years]					
		100	50	20	10	5	2
		X [mm]	X [mm]	X [mm]	X [mm]	X [mm]	X [mm]
KAVAJË	24	7.84	7.02	5.95	5.12	4.26	2.92
	12	13.01	11.59	9.77	8.36	6.86	4.65
	6	20.02	18.13	15.45	13.40	11.19	7.88
	2	44.46	40.20	34.53	30.27	25.54	18.45
	1	69.05	62.43	53.92	47.30	40.68	30.27
	0.50 (30 min)	105.95	94.59	81.35	71.89	60.54	45.41
	0.33 (20 min)	124.88	113.52	99.33	87.98	76.63	56.76
	0.1667 (10 min)	175.91	158.89	141.86	124.84	107.82	85.12

## ▪ **CONCLUSIONS**

Based on the results above, it can be deduced that IDF curves of the pluviometer stations are not provided from the direct measures, but we think that generation from IDF curves of the pluviograph stations of the same climate sub-region is a good approximation, in the condition of the poor or no rainfall data in the places of interest for feasibility studies or the studying of a technical proposals for the public or civil works in the zone.

It is sure that, more exact data (or curves) need full analysis including all the physical, geological and hydrological parameters in order to provide more trusted data. Or, if it will be the case and there will have enough time, direct measures of the rainfall can be done. These measures must be done in as many points of the area or zone as possible, for a period of some years (at least 2, 3 or 5 years).

## ▪ **REFERENCES**

[1] Instituti Hidrometeorologjik, Akademia e Shkencave e Shqipërisë, 1985, Manuali i Shirave Maksimale me Siguri të ndryshme