The analysis of a five-storey brick Masonry building "type" 77/5

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ABSTRACT

This paper presents the main results of numerical analyses carried out to evaluate the seismic response of an existing brick masonry building, *type 77/5,* built in 1977.(*fig. 1*)
This type is a representative of many other brick masonry buildings built in 1975-1990, in Albania.
The main reason why this building was chosen for analysis is: Its *floor plan derives from regular geometry, based on recommendations of the Eurocode 8* [6]. [**4.2.3.2 Criteria for regularity in the plan,** pg. 48, Part 1]

This study firstly intends to analyze and after to propose a way how to rehabilitate this type of building, if this result necessary after the analysis.
The study comprehended analysis based on 2 steps:

- a linear analysis, with help of finite elements model

- a nonlinear analysis, carried out with a simplified modeling procedure.

These numerical analyses refer to the strengthened building. The results showed that both procedures were useful to investigate the structural problems. The finite elements model furnished a good prediction of the masonry stresses under vertical loads and the modal response of the structure. [13]

The non-linear analyzes, with simplified method is performed based on the AM quake program. For this analysis a value of ag = 0.27 m / s2 was accepted.

The results of the nonlinear analysis are not the subject of this publication.

Key words: brick (9), building (19), masonry (11) wall (10), slab (4) concrete (4) seismic (7)

INTRODUCTION

Fig. 1 - The **3D** view of the building **77/5**

During the January 1988 earthquake, I used to live in a building type 77/5(Fig. 1). Although the damages that the building experienced were small, their locations were rather interesting. Based on the studies done thus far in seismic behavior of masonry buildings, the damaged areas were the same as those predicted for such buildings. That is the main reason why i choose to investigate this topic even further, utilizing the modern-day software advancements.

While this 5 storey building makes a considerable percentage of the residential buildings, all over Albania, the basic question is: "Are safe these buildings under seismic actions, to be housed from so many families?"

The structural stability of existing masonry buildings is a topic of great interest, notably in the light of evolution of technical regulations, i.e. the continuous improvements that have been made in the theory of masonry buildings.
This raises on the one hand, the choice of conservative techniques for the reinforcement of these inhabited buildings, and on the other hand the development of adequate numerical procedures for their seismic verification.
Different models for the assessment of masonry structures exist in the literature: they are one-dimensional (frame or macro-element) and two-dimensional (finite elements).

Among these, those based on finite element modeling and those that use simplified macro-element models are of particular importance.

- The finite element method offers numerous possibilities for modeling all structural cases, however, nonlinear analyzes are particularly cumbersome from the point of view of computation and the results reading.

The poor tensile strength of the masonry does not allow the direct use of elastic models linear for the prediction of the response and the damage of a building, subject to seismic actions. [12].

From this perspective, the use of a finite element model in the linear field, ETABS model, developed *by Computer and Structure Inc.*, in our case, appears interesting, for study of the stress state, under the action of static loads and the modal behavior of the building.

- The one-dimensional ones are based upon a simple approach which includes models that schematize the structure as an equivalent frame. The first frame model was proposed by Tomazevic (1978) and it is the well known POR method [9], where the masonry walls are schematized by a set of piers connected by a rigid spandrel.

Many of the macro-element methods developed as evolutions of the POR method, are based on an incremental iterative procedure (non-linear static analysis) in which, the seismic load, is evaluated for the **collapse of the building**. Among them are 2 programs that we used in our analyzes, such **AM-Quake** and **Atena**. They perform non-linear dynamic analysis, with step by step technique, for masonry buildings with rigid floors in their own plane and congruent with the walls.

MATERIALS AND METHODS

The main purpose of this study is to analyze the effect of seismic action on the sustainability of buildings, type 77/5 [11]

The main building material is **brick masonry**.

The bricks are clay bricks, **Class = 7.5 N/mm²**

Cement mortar is **Class = 2.5 N/mm²**

The ground and the first floor walls of the building are 38 cm thick. The second till fourth floor walls are 25 cm thick.

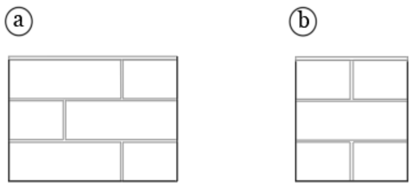


Fig. 2 - Masonry sections: **a**- wall 38 cm ; **b** – wall 25 cm

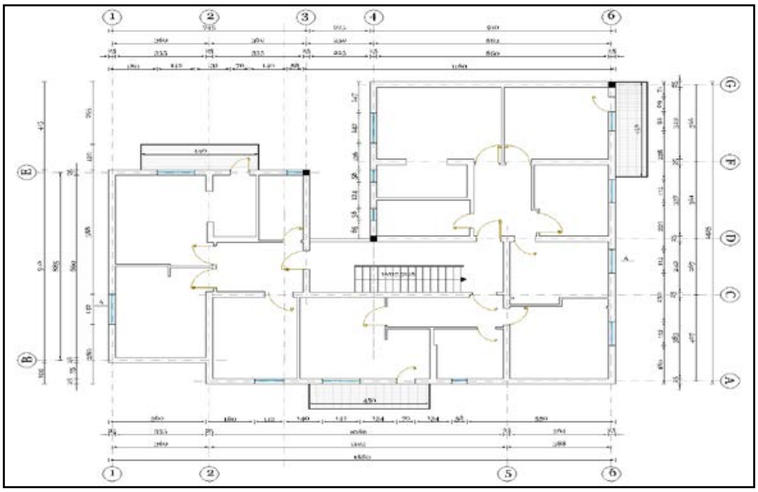


Fig. 3 Ground floor plan [11]

Based on above materials, bricks and mortar, Table 1 give this *Resistance of masonry:*

$$f_k = 1.1\ N/mm^2$$

Tab.1 Resistance in pressure, $\mathbf{f_k}$ of masonry [5]

Nr	*Brick class*	*Mortar class (N/mm2)*						
	N/mm2	*10*	*7.5*	*5.0*	*2.5*	*1.5*	*0.4*	*0.0*
1	*15*	*2.2*	*2.0*	*1.8*	*1.5*	*1.35*	*1.2*	*0.8*
2	*10*	*1.8*	*1.7*	*1.5*	*1.3*	*1.1*	*0.9*	*0.6*
3	*7.5*	*1.5*	*1.4*	*1.3*	*1.1*	*0.9*	*0.7*	*0.5*

The intermediate floor slabs are type Zoellner, cross section shows in Fig.7. They are composed of bricks height 15cm, filled every 20 cm with concrete, width 8cm.

The concrete grade is accepted relatively low, C15/20, due to the bad quality of raw materials at that time.

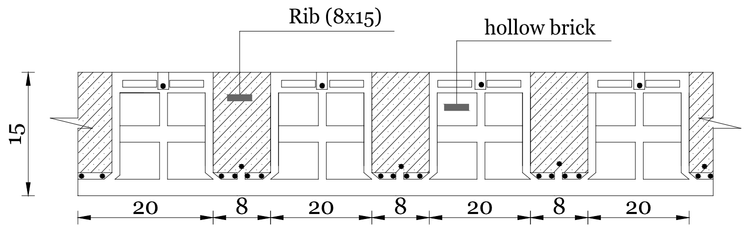


Fig. 4 Slabs cross section

In Etabs these slabs are converted in secondary beams, they transmit the load in one direction, in X or Y respectively.

The foundations of these buildings are stone walls, with cement mortar, a significant weakness, especially if we consider the preparation conditions and the quality of participant materials, especially the cleanliness of sand and gravel, at that time. I base this on my several years of experience in construction site. The foundations effect on building safety belongs to another analysis.

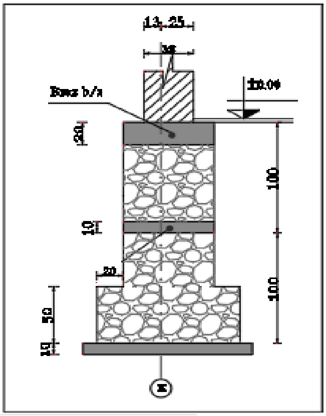


Fig. 5 Typical foundation section

The masonry elasticity modulus **E,** for serviceability conditions, in **EC6** is recommended **E= 1000** $\mathbf{f_k}$ N/mm2, while for the calculation on the last limit state (mainly in **nonlinear analysis**) is recommended to use the value **600** $\mathbf{f_k}$ **N/mm2**. [6]

From various comparisons with experimental values, (Tomazevic 1999) results that:

- "**Recommendations in Eurocode lead to overestimation of the modulus of elasticity**".

Author Thomas Zimmermann* (Zimmermann, et al., 2012) recommends the following equation as closer to experimental values [5]

E = 300 $\mathbf{f_k}$ [N/mm2] = 300 *1.1 = **330 N/mm2** **(**in nonlinear analysis)

RESULTS AND DISCCUSSION

It should be noted that **KTP.N.2-89** (Technical Design Conditions, publication of the Seismological Center, Tirana) recommends some essential limitations for the floor plans of the buildings. Thus, in fig 1, the dimension "**c**" must respect the condition: c < 0.25 B. [7]

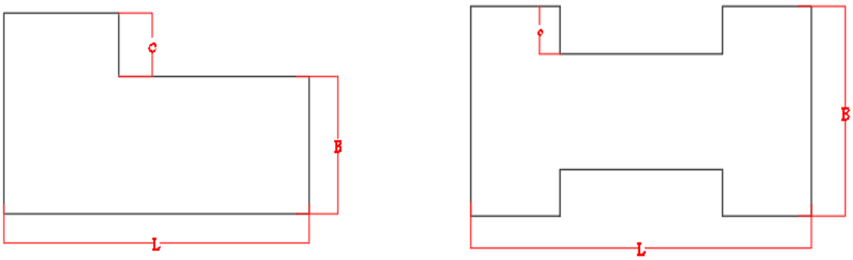


Fig 6- Illustration of KTP-N2 recommendations

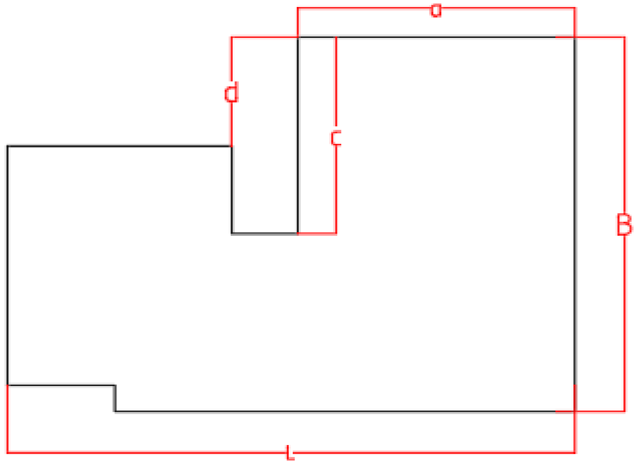


Fig. 7 Planimetric form of building 77/5

The main dimensions of the building are: L = 18.60; B= 14.24; c = 7.45 ; d= 4.15

Limitations of KTP: d/B = 4.15/ 14.25 = 0.29 > 0.25, but: 7.45/14.25 = 0.52 >>0.25 !!!

- The recommendation 4, page 11 of KTP-89 states that, if the condition **e/L < 15%** is met, the eccentricity is considered insignificant, where **e** is the eccentricity in one direction, i.e.:

  e = (10.21- 8.38) = 1.83 m and in our case, we have: 1.83/18.65 = **9.81%.**

  The condition is met.

- Let verify **[EC 8, pg.48]**: **4.2.3.2 Criteria for regularity in the plan:**

"for each fracture, the surface that is included between the contour of the intersection and a convex polygonal line, does not exceed **5%** of the intersection area.

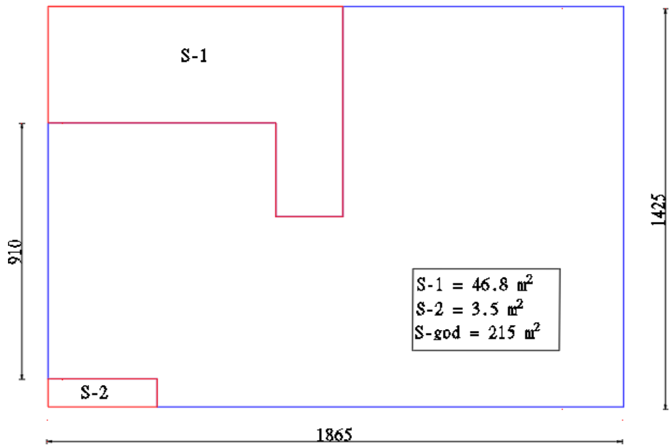


Fig. 9 The missing areas (1,2,3)

The missing areas to the total (full rectangular shape), is **51.4m2**, while the total area is 265.3 m2.

In percentage, the missing area, to the total is: 50.3 / 265.3 = **19 %!!**
Criterion is not respected, the value exceeds 5**%**
The mass and the gravity center are defined, and they are as below:

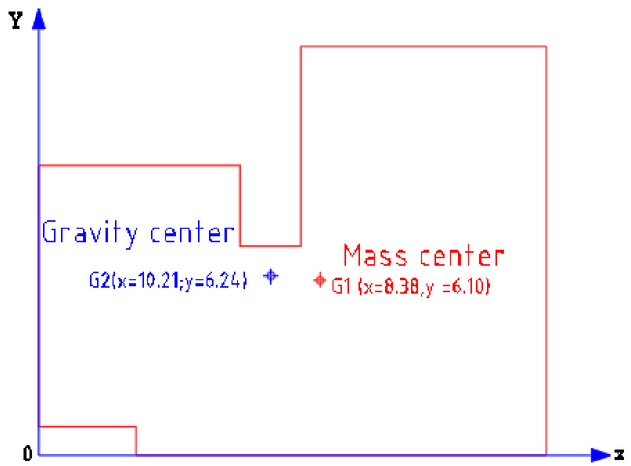


Fig.8 Mass and gravity center

Gravity center	**Mass center**
X_C = 10.21 m	X_C = 8.38 m
Y_C = 6.24 m	Y_C = 6.10 m

THE ETABS DATA INPUT

Loads

After calculation, the slab dead load is **200 kN/m²**.

Based on the EC, we accepted these loads:

Live = 200 kN/m2; Additional dead load = 200 kN/m2

Also, based on the Department of Seismology, Institute of Geosciences data, for the case of Tirana land, is accepted :

- land type - category C,
- acceleration ag = 0.25g.

Seismic data

Since we want to analyze the most unfavorable case, we choose from the type of elastic response spectra, the type "1" of the earthquake, based on the EC recommendation [6], with magnitude MS > 5.5. So, we used spectrum type 1, the masonry ductility factor $\mathbf{q = q_0 k_w \geq 1.5}$, and **3%** extinction. [6]

Below we present the tables with the data that have been entered in the Etabs program, on the basis of which have been obtained the respective results.

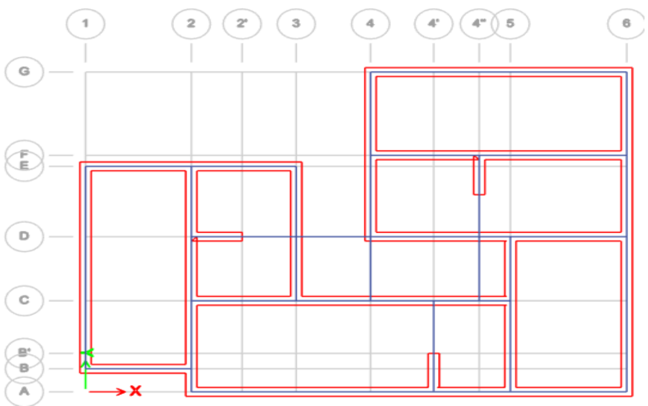


Fig. 10 - Plan type, input in Etabs

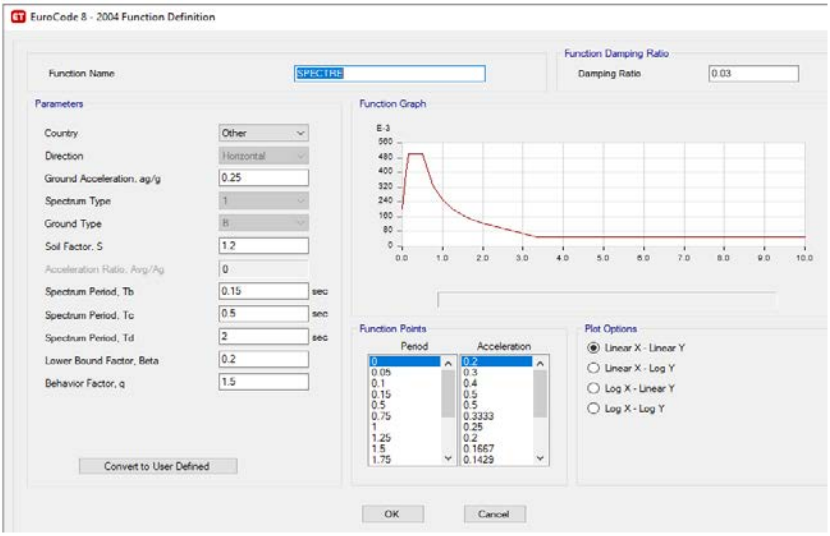


Fig.11- Seismic spectra, periods and accelerations

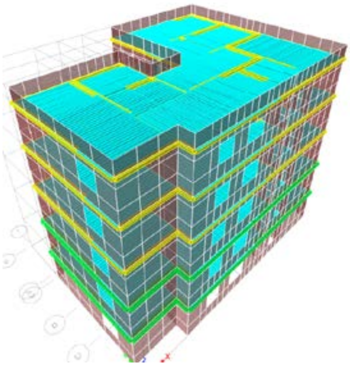


Fig. 12- Etabs 3D

(Yellow- concrete parts)

Fig. 13 - Etabs brick data

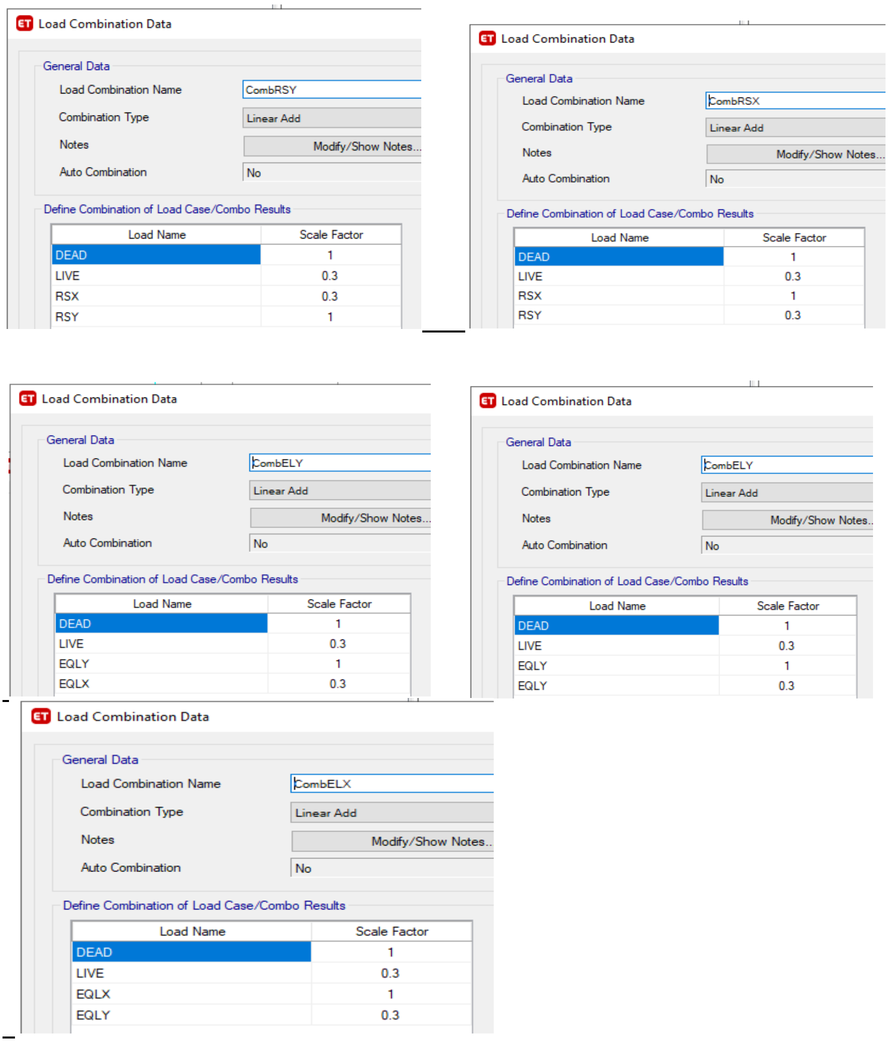


Fig. 14 Etabs main load combinations

The period of personal oscillations, according to the recommendations of EC 8 should be:

$$[T] = 0.05 \times Hg^{0.75} = 0.05 \times 14.2^{0.75} = 0.366 < T = 0.728 \text{ s !!!}$$

where **0.728 s** is the period in the first form of oscillation.

LOCAL CONTROLS:

Based on the Etabs analysis we have selected the walls with the greatest stresses and deformations. Some from the stresses and deformations results, which exceeds the allowed values are presented below, through respective screenshots.

Looking at the stress diagrams, we see that, the **upper area**, [upper floors], suffer mainly under the effect of tensile stresses, while the lower part (1-3) mainly, is under the effect of compressive surface stresses.

(The blue arrow indicates the analyzed elements)

AXIS 2-2

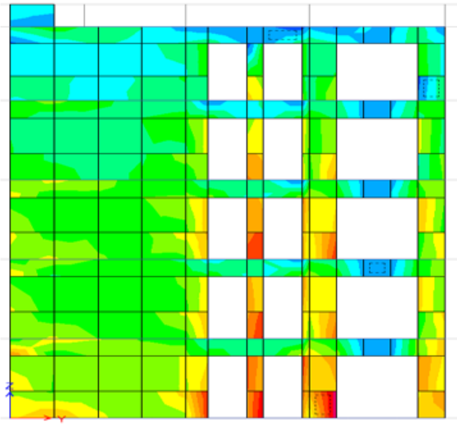
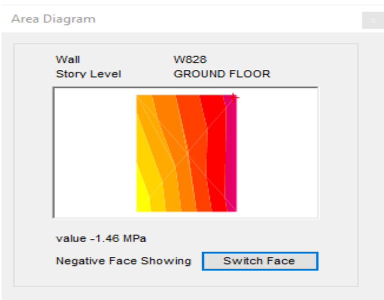


Fig. 15- Axis 2-2 elevation. The blue arrow indicates the most stressed element W828



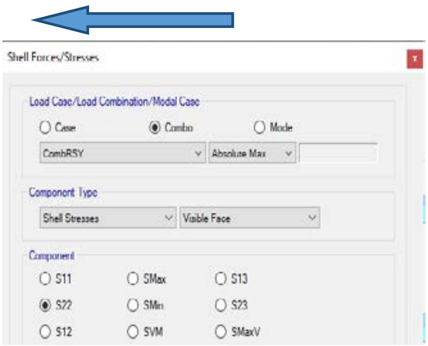


Fig. 16- W828 element detached from axis2-2 **Fig. 17**- The analyzed stress **s**2-2 in W88 element

The max value on this axis is the compression **s**2-2, with value = -**1.46 MPa > - 1.1MPa**

AXIS 6-6

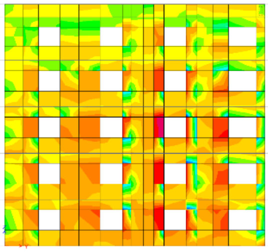
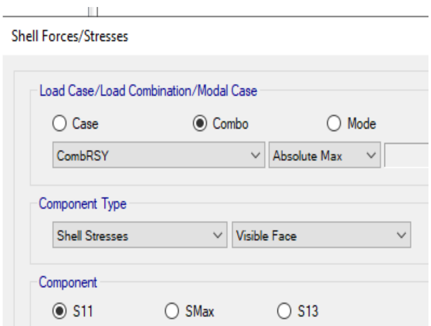


Fig. 18 - Axis 6-6 elevation. The blue arrow indicates the most stressed element W559



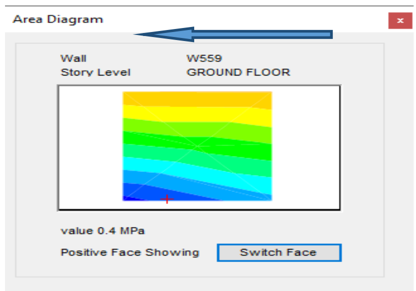


Fig. 19- Analyzed stress **s**1-1 of element W559 **Fig 20** - W88 element detached from axis2-2.

The max value on this axis is the traction **s** 1-1 with value = 0.4 MPa

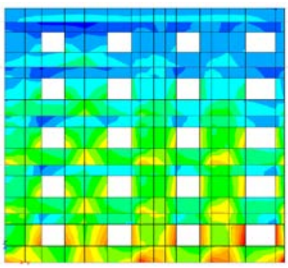
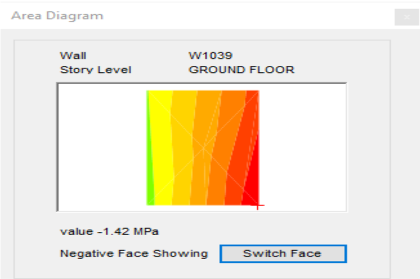


Fig. 21 - Axis 6-6 elevation. The blue arrow indicates the most stressed element **W1039**



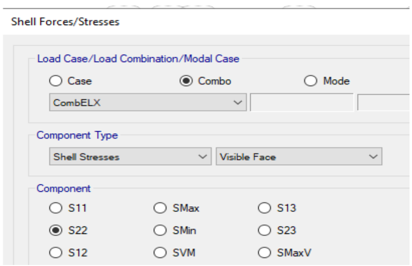


Fig 22 – W1039 element detached from axis2-2. **Fig. 23** - Analyzed stress **s** 2-2 of element W1039

The max value on this axis is **s** $_{2-2}$, in compression, with value = -1.42 MPa

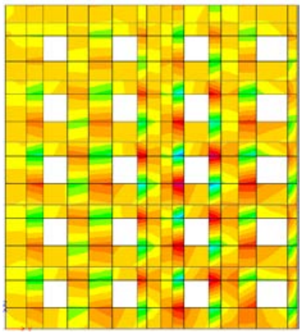


Fig. 24 - Axis 6-6 elevation. The blue arrow indicates the most stressed element W1053

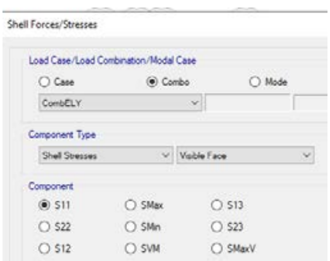


Fig. 25 - Analyzed stress **s** 1-1 of element W1053 **Fig 26 –** W1053 element detached from axis 6-6

The max value on this axis is **s** $_{1-1}$, in traction, with value = 0.79 MPa

AXIS 6-6 Deformation

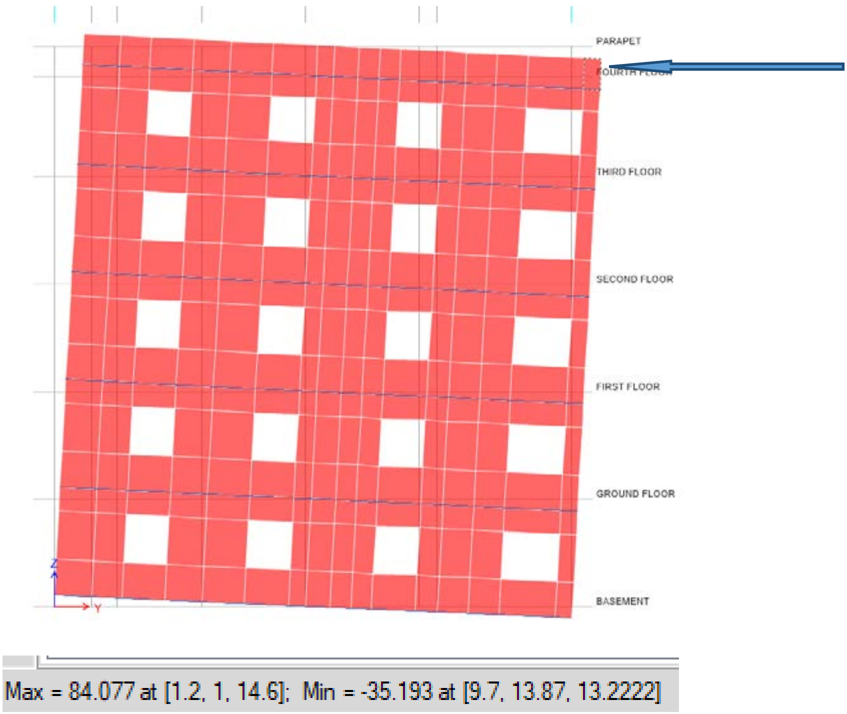


Fig. 27 - Deformed shape of axis 6-6, for EQLY combination

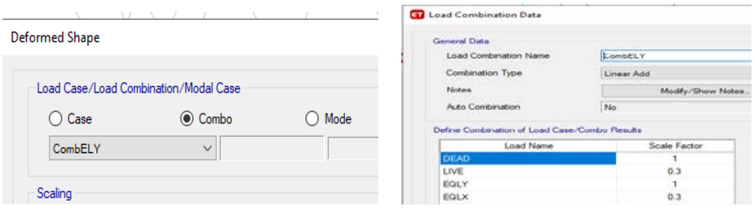


Fig. 28 – The ETAB s ELY combination, and its components

Max displacement = **8.41 cm** > > **4.73 cm**

The recommended allowed displacement of the building on the top must be 1/300 H = **4.73** cm

CONCLUSIONS:

The building presents these main problems:

1- Its period 0.728 sec and not 0.336 as recommended by EC8 for masonry buildings
2- The building has mural elements, in which the values exceed [**s**] pressure = - 1.1 MPa
3- The most problematic are the elements that suffer in tractions, since the masonry is very sensitive to it. Thus, the allowable tensile values for masonry are [**s**] pressure = 0.1 MPa, while in the whole masonry of the building, tensile stresses greater than 0.1 MPa occur. This is also the main weakness of the building, which requires reinforcing surface interventions throughout the masonry.
4- Also, the building has significant displacements, which exceed those allowed

However, the next steps of analysis, (the non-linear ones) will highlight the other weaknesses of this building.

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Thermo power plant "Kosovo B"– a pollution source for Sitnica River

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ABSTRACT

Kosovo's waters are unevenly distributed in time and space. Kosovo is water scarce, and it also has the low level of water resources development and storage. In particular Iber basin is water stressed, but in the next 20 years it is expected that all Kosovo's basins will be water stressed [1]. This is due to population and general economic growth, and resource variability. The anticipated revitalization of the irrigation and mining sector and additional demands from the energy sector will increase pressure on new water demands. For these reasons, the water quality of existing resources will become an ever-growing problem if not addressed now.

Keywords

Clean rivers; industrial pollution; protection and sustainable use of water resources

INTRODUCTION

Sitnica is the main river stretching in Kosovo valley that confluence with Ibar, one of main river basins in Kosovo which further flows towards north of country joining Danub later. The watershed covers a total area of 2,873km^2, or about 25% of the total area of Kosovo. Sitnica is lowland river with very variable flow, being very low during summer 0,5m^3/s while during winter reaches up to 328m^3/s [2]. It originates in the northeast foothills of the Sharr mountains in the municipality of Ferizaj, where it is called Sazlija. It then heads to the north and the plains of Kosovo where it is joined, by several tributaries. In the suburbs of the capital Pristina, it enters the mining basin of Kosovo and is joined by two much polluted tributaries: Graçanka and Prishtevka. It is in this section that the quality of its water deteriorates sharply with wastewater discharges from Pristina, wastewater from industries located along its course (coal mines and thermoelectric power stations), and landfills and storage of solid wastes along the river banks etc.

Kosovo is at very early stages of building the facilities for treatment of wastewater. Only 0.7% of produced wastewater is treated before its return to the nature [3]. All other wastewater is discharged without any prior treatment to nearby streams and rivers.
The main energy production industry (thermopower plant “Kosovo B”) is

located nearby Sitnica and their operation is not compliant with environmental protection standards and regulations.

The wastewater generated from the operation of lignite-fired power plant with minimal treatment such as sedimentation, is discharged into Sitnica river.

The wastewaters discharged from power plant are as follows:

- Bottom ash removal water
- Heavy Fuel Oil polluted water
- Run-off water, potentially polluted by oils and hydrocarbons (including coal yard)
- Water Chemical Treatment plant effluents, including:
    - Sludge produced by softening (decarbonization - DECA) treatment
    - Water from regeneration of ion-exchange resins
    - Overflow of decarbonization (DECA) and demineralization (DEMI) water basins
- Sanitary wastewater

METODS AND MATERIALS

Through wastewater sampling in six discharging points from operations of thermal power plant “Kosovo B” and their laboratory analyses, we have analysed the pollution that this industry being the main source of energy production for the country, is causing to another important natural resource Sitnica river.

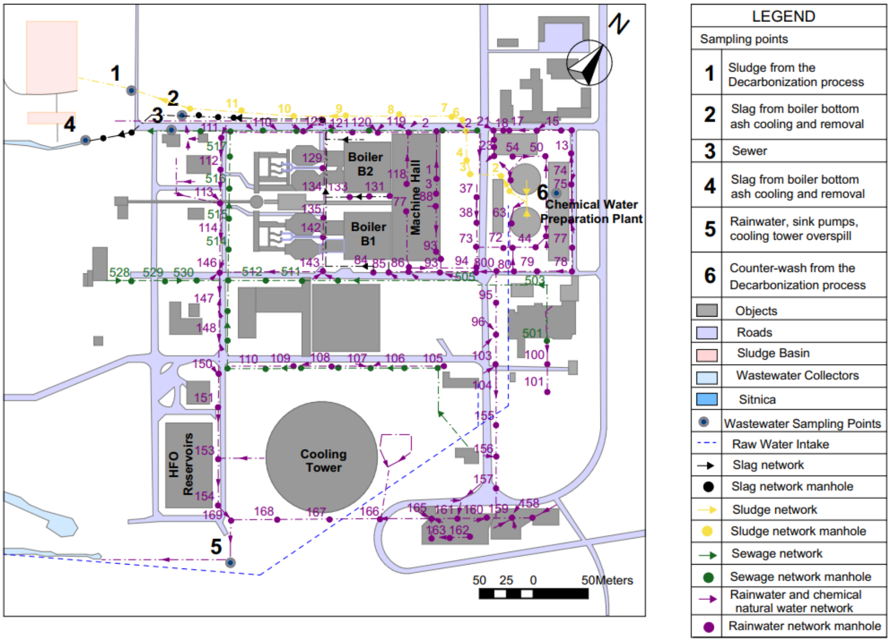

Figure 1: Layout of the thermo powerplant Kosovo B and the locations of the six sampling points

In Figure 1 we have presented the layout of the thermopower plant "Kosovo B" and the locations of the six points where the wastewater samples have been taken for analyses as follows:

1. Sludge from the Decarbonization process. This wastewater is the sludge that is produced from raw water treatment plant that treats water for the energy production;
2. Slag from boiler bottom ash cooling and removal. It is the water that is used to cool the ash created from coal burning before it undergoes sedimentation;

3. Sewer is the sanitary wastewater collected from administrative buildings and kitchen;
4. Slag from boiler bottom ash cooling and removal. The water that is used to cool the ash created from coal burning after sedimentation and before discharge into river;
5. Rainwater, sink pumps, cooling tower overspill. This is mainly drainage water, and spill from cooling tower;
6. Counter-wash from the Decarbonization process. Water that is used to wash the filters in the decarbonization process.

The testing methods and standards applied for analyses are mainly ISO, DIN and EPA standards based on parameters each specifically and they are shown below in Table 1.

In one of the columns of Figure 1, we have presented the Industrial emission limits according to national Administrative Instruction nr. 30/2014 that are applicable for discharges from industry into the river.

Table 1: Wastewater analyses from six samples

Parameter	Unit	Method	Industrial emission limits acc. AI nr. 30/201	Results					
				1	**2**	**3**	**4**	**5**	**6**

			4						
Flow	l/m			17.0	5510	18.9	90.0	45.0	6.0
Temperature	°C	DIN 38404 C4		14.6	25.2	20.1	29.3	31.2	16.5
Electrical conductivity	μS/cm	DIN 38404 C8		170	340	620	390	440	120
pH		ISO 10523		10.57	8.72	7.81	9.74	9.92	9.99
Colour	Pt/Co	ISO 7887:1994		None	None	None	Light black	Light black	None
TSS	g/l	ISO 11923:1997	35-60	6.0	40.0	172	128.0	16.0	20.0
TDS	mg/l	US EPA 8163		80.0	200	340	240	220.0	200
TPH	mg/l	EPA 1664			<20	<20			

Total F	mg/l	EPA 365.3			0.55		0.63	0.59	
Total CL	mg/l	ISO 7393:1985			<0.03		0.03	0.06	
Al	mg/l	EPA 3015A, EPA 6010C: 2007	3		0.470		0.320	0.726	
As	mg/l		0.1		<2 ppb		<2 ppb	<2 ppb	
Cr	mg/l		1		0.039		0.038	0.036	
Hg	mg/l		0.01		< 1 ppb		< 1 ppb	< 1 ppb	
Mn	mg/l				0.012		0.016	0.060	
Ni	mg/l		0.5		0.101		0.132	0.130	
Pb	mg/l		0.5		< 1ppb		< 1ppb	< 1ppb	
S	mg/l		400		4.066		9.210	9.240	

Zn	mg/l		1		0.124		0.111	0.132	
Ca	mg/l	ISO 7980:1986, EPA 6010 C:207		8.47					
Mg	mg/l	ISO 7980:1986, EPA 6010 C:207		1.80					
BOD	mg/L	ISO 5815:2003	25			83			
COD	mg/L	ISO 6060:1989	125			236			
N (Total)	mg/L	ISO 5663	20			17.68			
P (Total)	mg/L	EPA 8048				1.16			

Faecal Coliform	Cfu/ml	ISO 9308-1				>300			
Escherichia Coli	Cfu/ml	ISO 9308-1	1000/100ml			>300			
Anionic surfactants	mg/L	ISO 7875-1: 1996				0.39			
Non-ionic surfactants	g/L	ISO 7875-2: 1984				0.07			

RESULTS

The results from analyses of the six samples of wastewater generated by energy production can be summarised as follows:

- The temperature of these wastewater discharges is between 14-29°C, that can be considered high for some aquatic life species
- Electrical conductivity varies between 120-620 µS/cm
- pH value is going from 7.81 up to 10.5 which makes these wastewaters basic
- TSS are above limit in two samples (3 and 4)

- **BOD and COD analysed in sample 3(sewerage) are above the limits and they show the organic load and total load of the wastewater**
- **It was noted that some of metals(As, Hg, Pb) are exceeding the limits.**

DISCUSSIONS

Pollution coming from thermopower plants represents important pollution pressure in Sitnica river, and its better management represents an important area for improving the ecological status of the river.

In order that the power plant operations are compliant with national legislation requirements and European Directives, based on studies, analyses and the results of the laboratory tests of the taken samples, the appropriate treatment facilities are proposed as follows:

- An appropriate wastewater treatment plant, consisting of a physical-chemical and biological stage should be designed and built in order to treat the wastewater streams: sanitary, bottom ash removal, Deca process sludge and atmospheric water in order to fully comply with environmental standards;
- For runoff and heavy fuel oils (HFO) contaminated water a basin should be dimensioned and built combined with appropriate treatment stages (sedimentation and skimming) in order to remove the pollutants;
- Check the possibility to re-use the treated wastewater in the plant (i.e. for ash transport) in order to reduce the water consumption;

CONCLUSIONS

Sitnica river is important water resource for central part of Kosovo and it must be protected. The achieve this goal there are a series of actions and investments to be undertaken.

On regards to the pollution from thermopower plant we recommend the:

- Construction wastewater treatment plant for industrial wastewater
- Construction and development of monitoring stations of water discharges from thermo power plant in Sitnica river and regular reporting to the competent authorities.

Kosovo as the rest of the Western Balkan region, enjoys an enlargement perspective. The policy development should be aligned with EU "acquis", and infrastructure should be implemented according to European codes and standards.

Country is struggling with the compliance with EU directives, especially with the Urban Wastewater Treatment Directive (UWWTD) and Industrial Emissions Directive (IED). The lack of appropriate facilities for wastewater treatment before their discharge into recipient represents an important gap in water sector that need to be addressed in order to comply with EU standards and regulation.

While water is a central issue in water security, it is increasingly clear that this goes beyond single sector issue topics and it percolates into all parts of society and economy.

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Solid Waste Management Aiming Biogas Production In Albania

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Abstract

One of the main environmental problems in Albania is the continuously increasing generation of municipal solid waste.

In many countries, sustainable waste management as well as waste prevention and reduction, have become major priority. Uncontrolled waste dumping (on the roads, river sides, etc.) in our country is no longer acceptable. Controlled landfill disposal and incineration of wastes are not considered optimal practices, as energy recovery and recycling of nutrients and organic matter is aimed.

Continuously efforts have been done for the improvement of this critical situation such as approval of laws, decisions, regulations etc., according to the National Strategy on Integrated Waste Management (2018-2030) and EU Directives 2008/98/EC on waste and repealing certain Directives.

In this paper are presented the characteristics of a wide range of urban solid waste, industrial solid waste and composition of the waste i.e. waste stream. As organic waste component represents the highest percentage (41% - 66%) at the waste composition should be used for biological treatment and for biogas production.

Keywords: urban solid waste, biogas, environment, waste management, generation.

Introduction

There is still a long way to go to close all resource cycles in the global economy. On the one hand, there are still considerable knowledge gaps concerning possible resource recovery and reuse practices. On the other hand, there are frequently significant political, social and economic obstacles to the implementation of the solution identified. [2].

Environmental sustainability is the core issue that will need to be addressed for development to focus on human well-being and yet stay within the limitations of planet's capacity. Environmentally sound waste management is one of the key elements for sustainable development. [1]. Waste is a global issue. If not properly dealt with, waste poses a threat to public health and the environment. It is a growing issue linked directly to the way society produces and consumes. It concerns everyone. Waste management is one of the essential utility services underpinning society in the 21st century, particularly in urban areas. Waste management is a basic human need and can also be regarded as a 'basic human right'. Ensuring proper sanitation and solid waste management sits alongside the provision of potable water, shelter, food, energy, transport and communications as essential to society and to the economy as a whole. Despite this, the public and political profile of waste management is often lower than other utility services. [1].

On a larger scale, when significant quantities of municipal or industrial solid waste are dumped or burned in the open, the adverse impacts on air, surface and groundwater, soil and the coastal and marine environment, and thus indirectly on public health, can be severe. [3]. Even worst taking into consideration Albania is a small mountainous country and the total land area covers 28 748 km2. Meanwhile it has a reach hydrographic net (groundwater, streams rivers, springs, lakes, wetlands).

The main problems, expressed in general terms, related mainly to: partial range of service coverage; insufficient collection and removal of waste; limited amount deposited and treated at landfill; a large number of deposit sites (authorized and unauthorized), which are outside the sanitary and engineering standards; limited number and poor quality of waste collection equipment and waste transport; lack of infrastructure for integrated waste management; unexpected change in the policies leading the development of infrastructure for final waste processing; poor implementation of the law and, in general, sub-legal acts; poor interaction and coordination of central government structures with local government and other interested parts.

Methodology

The most important part of this study is the identification and the collection of the data and then selection of them, from the Central Government Institutions, National Agencies, INSTAT, etc, related with the topic.

Processing and calculation of above mentioned data, preparing tables and graphs to obtain indicators, needed for results discussion and conclusions.

Results and Discussion

Monitoring on solid waste generation and waste management is a very important process toward sustainability. Taking into account the monitoring data on different types of solid waste, can prepared the strategy for their management, recycling and reuse according to EU Directives and Albanian Laws. [6][7][8][9][11][12][13][14].

The data on the amount of the **generation of urban solid waste** is only approximately known, because different institutions used different methodologies and practices. Nevertheless the data indicate, within the period of 15 years, a significant increase in urban waste generation. Based on this study during the period 2013 – 2018 (Table 1, 2 and Figure 1, 2), urban solid waste amounted to 0.940 thousand – 1.2 million tones and comparing with the generation of waste in 1998 (520 thousands tones), the amount recently is doubled [4] [5]; in 2018 the generation of urban waste is increased about of 10%. It is expected that the quantities of domestic waste will increase in the future as consumption rises and more household are incorporated in the regular waste collection network.

Table. 1: Generation of managed urban solid waste in years (tonnes)

Solid waste	Urban solid waste (tonn)					
	2013	2014	2015	2016	2017	2018
Total waste managed	940,160	1,228,884	1,413,233	1,300,373	1,253,913	1,172,907
Household waste	827,828	970,818	1,142,964	1,072,236	1,109,399	1,097,705
Industrial waste	112,332	258,066	270,269	228,137	144,514	227,366

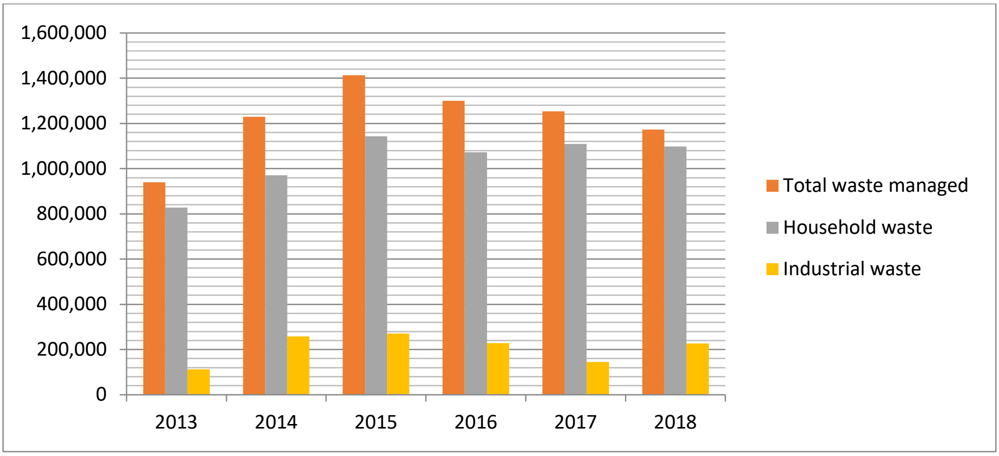

Figure1. Generation of managed urban solid waste

Table.2: Generation of managed urban solid waste in years (%)

Solid waste	**Urban solid waste (%)**					
	2013	**2014**	**2015**	**2016**	**2017**	**2018**
Total waste managed	100	100	100	100	100	100
Household waste	88	79	81	83	89	83
Industrial waste	12	21	19	17	12	17

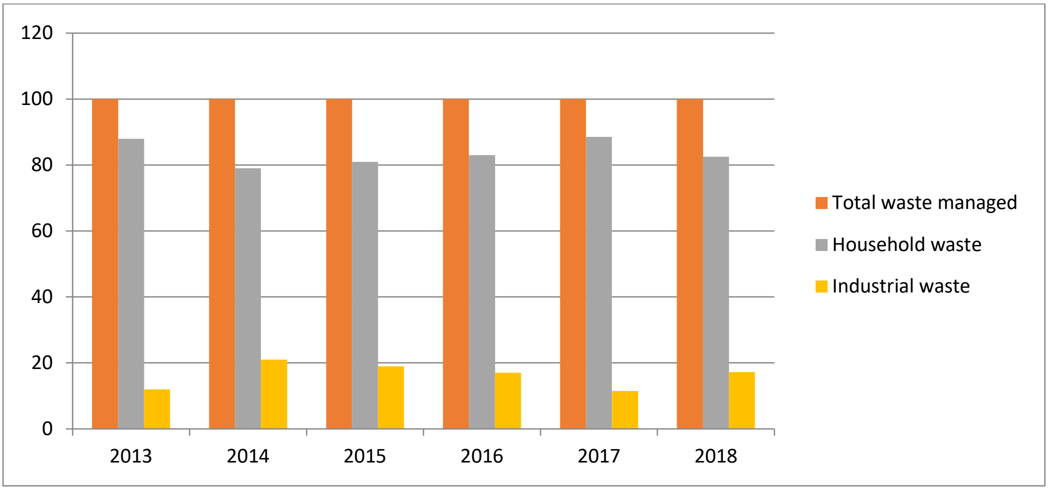

Figure 2. Generation of managed urban solid waste

The sludge from the growing number of Waste Water Treatment Plants, the growing number of discarded car wrecks, the solid waste from rural area and the spoiled up and down on the river sides, lakes are not included in the urban solid waste. These waste impact the underground and surface water quality.

According to the estimated situation during the study, (see Table. 2, Figure. 2) waste from industrial sector represent 12 – 20% of total urban waste (see Table 1, 2 and Figure 1, 2). Comparing with the amount generated in 1998 (415 thousand tones) it's noticed that the quantity is reduced twice in time. Even in 2018 the amount of industrial solid waste (227 thousands tones) is much more less than that of 1998. [4] [5]. This declined trend refers to the closing of many manufacturing, mining industries, leather processing and electricity supply, etc. According to the estimated situation in 2018 industrial waste represent 17% of total waste quantity.

A very important indicator related with sustainable development is **generation of waste stream.** It means the composition of total urban waste. This indicator in Albania is started to monitor from 2013 and indicate the improvement of the waste management and a better implementation of the Laws, Decisions and Regulations. [6][7][8][9][11][12][13][14].

According to data acquisition from the study, the highest share in the entire structure of urban waste is that of organic waste (61.2%); see Table 3 and Figure 3, followed by plastic waste (9.7%) and cupboard/paper waste (7.7%).

Table 3. Generation of waste stream in percentage

Waste stream	Generation of waste stream in %					
	2013	2014	2015	2016	2017	2018
Organic waste	41	50.2	51.4	49.52	45.9	61.2
Wood waste	4	6.1	4.6	5.84	3.9	5.1
Biodegradable animal waste						
Cardboard paper waste	12	8.7	9.9	7.87	9.5	7.7
Plastic waste	14	9.1	9.6	10.01	16.8	9.7
Glass waste	7	4	4.5	4.24	4.8	3.8
Textile waste	3	2.6	2.9	2.81	3.2	2.2
Ferrous and non-ferrous metal waste	3	5.8	4.8	3.38	2.7	1.5
Hospital waste	1.9	1.2	0.51	0.26	0.21	2.65
Inert waste	3	3.7	8.2	11.9	7.4	5.5
Electric and electronic waste	9	8.1	1.1	0.84	1.2	1
Other waste	2.1	0.5	2.5	3.34	3.4	0.1

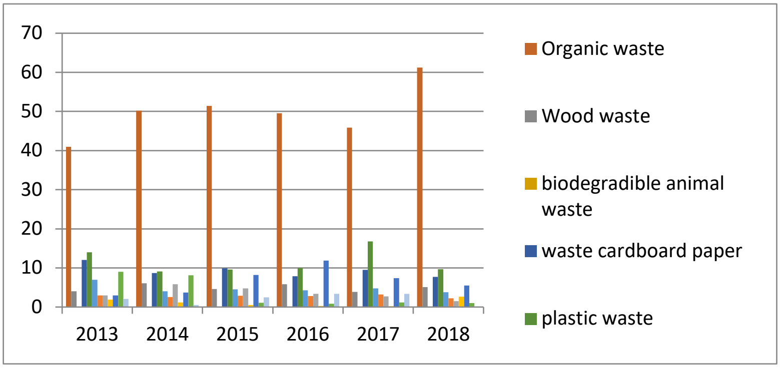

Figure 3: Generation of waste stream in percentage

Organic waste component represent a percentage from 41% to 61% of the material composition of urban solid waste. A large part of these waste are bio digestible and can used for production or utilized as potential substrate in anaerobic digestion to produce biogas, renewable source of energy and environment friendly too.[15]. This share is nearly constant in 2013 – 2017 while there is an increase about 10% in 2018 while the proportion of other materials varies in years. The main decrease is in the share of electric and electronic waste followed by plastic waste and less in glass waste. [5].

According to the data of the study, the high quantity of the organic component, according to the National Strategy of Integrated waste management may be used biologically for many purposes which will find out during the next step of the study. [10]. Also some of the other components of the solid waste are suitable for recycling and reuse.

Conclusions

The generation of total solid waste is increased every year, the major part is household waste is up to 83% and industrial waste is less than 20%.

In the total percentage of solid urban waste, organic waste component represents the highest percentage (41% - 66%) at the waste composition and should be used for biological treatment and for biogas production, which will find out during the next step of the study. [15]

As landfilling and incineration are not considering optimal practices, biogas production from the organic waste will be one of the best solutions as renewable energy sources, reduce greenhouse gas emission, contribute to EU energy, environmental policies and sustainable waste management strategies.

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