

Need for an Emergency Operation Centre in Surat city

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Abstract: A rapidly growing industrial metropolitan of Surat is prone to many natural and human-made disasters like floods, earthquake, chemical incidents, war, stampede and so on. Such events lead to frequent loss of lives as well as infrastructural facilities. To prevent such injuries and damages, the central government is advocating for local governments to act proactively and establish emergency operation centre in many cities. It also is developing capacities for preparation of strategies and disaster management plans at various tiers of administration. The prime focus is leveraged for being prepared during emergencies to gather information, develop and use of decision-making tools and centrally direct necessary actions that require close coordination among government officials. An Emergency Operation Center (EOC) is a centralised location where response agency leaders meet to coordinate the response to an emergency or a disaster. An EOC and its sub-centres can be planned by the intensity of the disaster that can occur in the particular area. EOC consists of many components, and there are several levels. The size of the EOC may differ according to a size of the response system required. It acts as a critical component of emergency management (EM). The primary goal for an EOC may be summarised as to coordinate for 'community continuity', in other words, help communities remain resilient in the face of disaster events. Current work is proposing an assessment of vulnerability and possibilities of various hazards in Surat. Based on analysis a suitable location will be identified along with design proposal for an EOC.

Keywords: Disaster Management Cycle, Emergency Management (EM), Emergency Operation Centre (EOC), Emergency Operation Planning (EOP), Recovery, Response, Surat

I. INTRODUCTION

Emergencies, crises, and disasters happen when people least expect them (Organization, 2015). To respond to these events taking place at an urban level, organizations such as the local body's Fire Department, Police Department, EMS and others work together within a co-located Emergency Operations Center (EOC). An EOC is a physical location for coordinating information resources to support incident management activities as well as used to build capacities of human resources. Such a centre may be a temporary facility, or it may be established in a permanent place. The National Disaster Management Authority (NDMA) of India was set up under the Disaster Management Act of 2005. (Dave, 2012) NDMA is the summit body for calamity administration headed by the Hon'ble Prime Minister of India and has the obligation regarding setting down arrangements, plans and rules for fiasco administration. The National Institute of Disaster Management (NIDM) was established to encourage limit building, preparing group partners, directing examination, documentation and a national level data facilitation. The NIDM performs in collaboration with other research foundations within the system having broader approaches and rules set around the NDMA. The Government of India is persuading the state governments to set up the EOCs expeditiously as mandated in the Disaster Management Act of 2005 at various levels. An EOC is more than just a physical facility with technical infrastructure. An EOC also has protocols, human interfaces and human resource requirements and an organizational structure. During a disaster, the emergency manager's role is somewhat comparable to that of incident commander (IC) overall responsibility for coordinating the response (Organization, 2015)

1.1 EMERGENCY OPERATION PLANNING (EOP)

The events of emergency, whether natural or manmade, accidental or intentional, have a potential to leverage adverse health and safety impacts for large segments of the human and animal populations. Towards mitigation approach to such incidents, the government must possess resources and capabilities necessary to prevent, prepare for, protect against, with a rapid and efficient response to and recover from all hazards. Such planning can be termed as emergency operation planning (EOP). It provides the measures, operating structures, roles and responsibilities, and mechanisms for direction and coordination of their resources before, during, and after disease outbreaks, terrorist attacks and other criminal acts, natural disasters, and any other incidents associated with products that pose a risk to human or animal health. (Oxford Research Encyclopedia of Natural Hazard Science, 2015). There are two levels of EOPs - Local EOPs and State EOPs.

1.2 EMERGENCY OPERATION CENTRE (EOC)

An EOC is a physical facility with technical infrastructure where decision makers meet to coordinate the response to an emergency or a disaster. Managing the response and recovery of natural and man-made disasters requires the coordination of multiple agencies and most often leads to the activation and staffing of physical or virtual emergency operation centre to aid with coordination efforts. Essential facilities at an EOC include- reliable access to communications, data and computational dispersed participants and assets. In reality, an EOC is composed of many parts, and there are several "levels" of emergency operation centres. The size and making of the EOC may differ according to the size of the jurisdiction system. Planning, designing, commissioning and management of EOC as a facility which can meet physical and organizational requirements necessary for an efficient and effective performance of EOC team is most crucial. The design process will start with defining functional needs, which may vary from one place to place but commonly include: coordination, policymaking, operation management, information management, documentation, public information, training and exercising. (Dave, 2012). EOC's need to be established, managed and controlled by national, state and local entities.

The types of EOC include virtual and physical EOC based on the facilities required for any particular area of the city. The needs and demands may vary from place to place based on the probability of intensity of occurrence of any disaster. To coordinate with different authorities and various government agencies, the EOC's can be generated on different levels. (Gujarat, 2003). Significant three levels of EOC are State Emergency Operation Center (SEOC), District Emergency Operation Center (DEOCs) and Taluka Emergency Operation Center (TEOCs).

Seven essential functions are identified for performance at various stages as before an event, during and after an emergency. These functions may vary by disaster management agenda. These functions are: Coordination, Policymaking, Tasks administration, Data Administration, Documentation, Public Information, and Training and exercising. EOC will be the primary communication, coordination and collaboration, and control point for all counter-disaster efforts and will operate under three primary conditions as Normalcy, Emergency without warning, and Emergency with a warning. A comprehensive emergency management programme has five commonly recognized elements (Organization, Framework for a Public Health Emergency Operation Centre, 2015). These elements include for risk assessment, prevention and mitigation, preparedness, response, and recovery.

The organizational structure of an EOC generally consists of three levels which are strategic level, operational level and tactical level. Strategic and policy level are the highest levels of the national disaster management structure, and it is responsible for strategic coordination and policy making. Operational level is responsible for effective coordination of all response element and maintenance of situational awareness for strategic level authorities. The third level of a response is the tactical management of response operations.

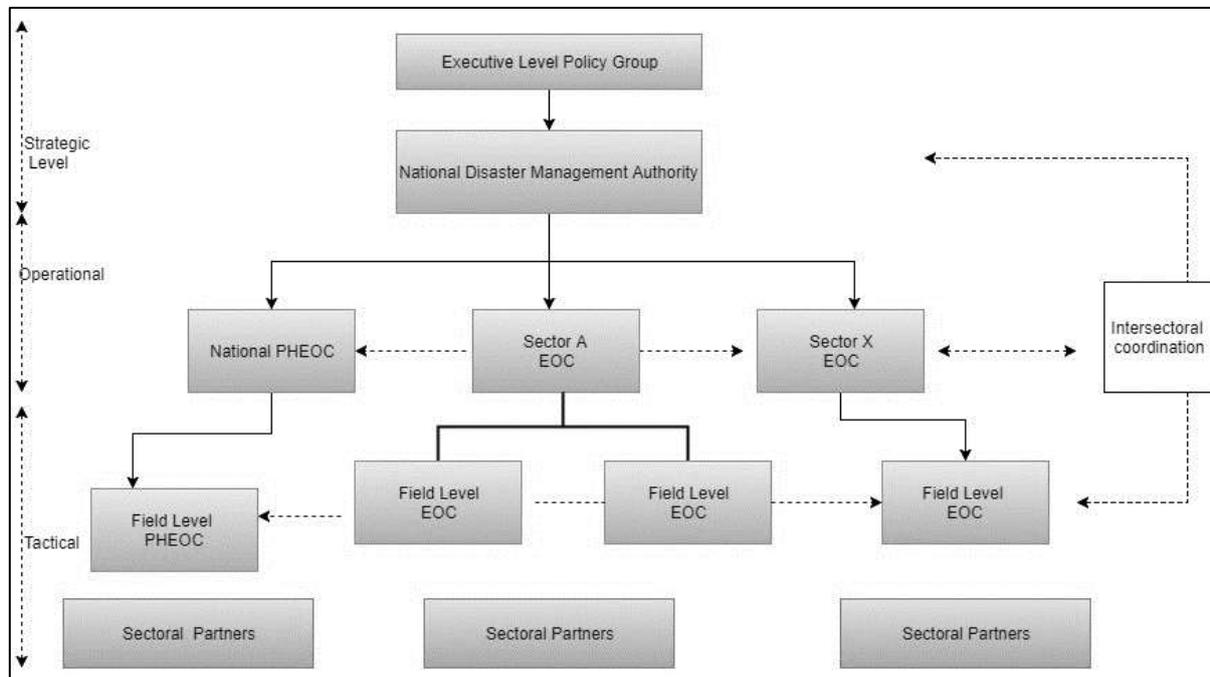


Figure 1 Organizational structure of an EOC
(Source: Framework for a Public Health Emergency Operation Centre, WHO)

II. SURAT – A PERSPECTIVE

Surat is a city flourishing in the western parts of India, in the state of Gujarat state, on the banks of the river Tapi and Mindhola. Anciently, it was known as Suryapur. Surat is one of a most dynamic cities in India with one of the fastest growth rate due to immigration from various part of Gujarat and other states of India. The population of Surat was reported around 4.47 million (Census 2011) with a population density of 13,680 persons/km². Surat has seven zones and 38 election wards. The sex ratio of the Surat is 756 females per 1,000 males. The literacy rate of the Surat is 87.89% in which the literacy rate of male is 91.22%, and female is 83.44%. As per census 2011, the decadal growth rate of the Surat is 55.29%. Surat has fastest growth rate due to immigration from various part of Gujarat and other states of India. It is one of the cleanest city in India. Surat is a second largest city in Gujarat state. Surat is the ninth major metropolitan area and eighth largest city of India.

Table 1 Key aspects of Surat

Surat	2 nd largest city of Gujarat in terms of area and population
Area	326.615 km ²
Population	44,66,826(Census 2011)
Density	13,680 persons/km ² (Census 2011)
Administrative zones	7
Sex ratio	756/1,000 Male
Decadal growth rate	55.29% (Census 2011)

(Source: suratmunicipal.gov.in)

With the passing years, the area of the Surat city has been continuously increasing, and this has also lead to the increase of the population. Surat continues the same tradition as people all around the country flock in for business and jobs. Surat has practically Zero% unemployment rate, and jobs are easier to get here due to the rapid development of various industries in and around the city. The figure below displays the decadal population growth trend as observed for Surat in the past century.

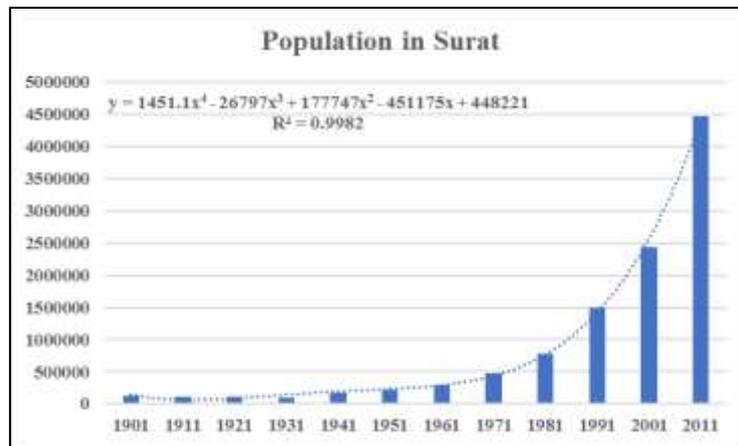


Figure 2 Population of Surat city (1901 - 2011)
(Source: Surat Municipal Corporation)

Further intervention in the sub-section of the paper discusses reported incidents, major flooding events, un-natural deaths, and weather analysis to make a reasonable justification for identifying the alarming need for an EOC in the metropolitan. Surat is a city prone to flooding events. The flooding is observed almost every year during the monsoon season.

Table 1 Major flooding events in Surat

Sr.	Flood event	Discharge (Lakh cusecs)	Period
1	1883	10.5	July
2	1884	8.46	September
3	1894	8.01	July
4	1942	8.60	August
5	1944	11.84	August
6	1945	10.24	August
7	1949	8.42	September
8	1959	12.94	September
9	1968	15.5	August
10	1994	5.25	Aug.-Spt.
11	1998	7.0	September
12	2006	9.09	August

(Source: Flood reduction plan for Surat city and surrounding region)

III. UN-NATURAL DEATHS IN SURAT

Birth and deaths are natural life cycle stages. Human life is valuable, and death of a person in an unnatural way should be of concern. Records of un-natural deaths for Surat area was obtained and compiled that is reflected in the table below. Alarmingly, it revealed that more than 1,000 citizens are died due to various un-natural causes and more than 1,500 persons in road fatalities during the decade of the year 2001 to 2010.

Table 2 Un-natural deaths in Surat city

Year	Population in Surat (persons)	Un-natural deaths in Surat (persons)					
		Fall from Height	Fire- Others	Other Un-natural causes	Total Un-natural causes	Road Accidents	Deaths in Road accidents
2001	24,33,835	123	84	81	951	867	118
2002	26,37,134	124	113	86	916	939	148
2003	28,40,433	114	115	92	9,25	942	147
2004	30,43,732	138	118	115	1,083	1,035	160
2005	32,47,031	134	162	114	1,174	1,179	230
2006	34,50,331	171	109	121	1,314	1,125	262
2007	36,53,630	200	119	138	1,501	1,222	259
2008	38,56,929	198	182	164	1,495	1,226	245
2009	40,60,228	166	118	178	1,375	1,140	217
2010	42,63,527	197	131	209	1,681	982	229
Total		1565	1251	1298	10657	2015	1565
Grand Total		12415					
Average		156.5	125.1	129.8	1065.7	201.5	156.5

(Source: Annual report of National Criminal Records Bureau, New Delhi, 2014)

Some of the significant reasons concerning natural events resulting in un-natural deaths were analysed and summarized in the sub-sections herewith.

3.1 DEATHS CAUSED BY DROWNING

The figure below explains the trend of deaths in Surat due to persons drowning in water. Surat has records of a mean annual loss of 136-person human lives under the deaths caused by fall from height. A total of 1,366 persons died with the reason during the study duration.

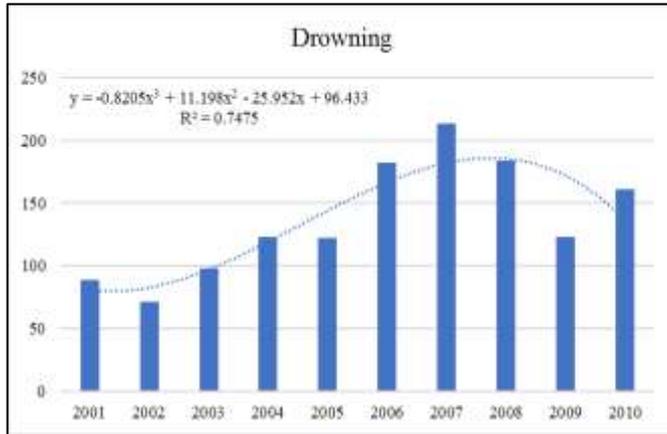


Figure 2 Deaths in Surat due to drowning

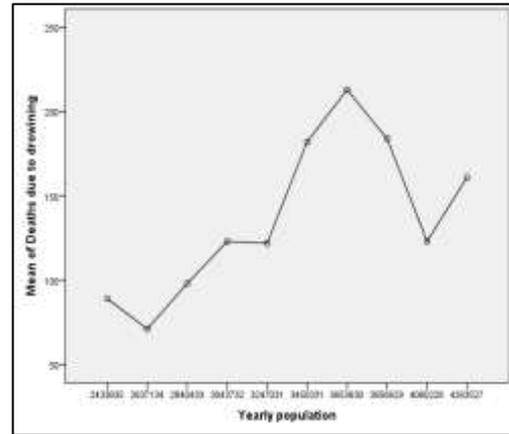


Figure 3 Population and drowning death relation

The increase in the deaths has a third-order polynomial relationship among itself. The value of R^2 is reaching to a high of 74.75% that shows strong inter-relationship among the data and its trend. Here, the rise in the population does not show much of significant dependencies among each other. The exceptional cases take place during the flooding in the monsoon season as well as a few from the swimming in the natural water bodies.

3.2 DEATHS CAUSED BY FIRE (OTHER)

The death due to fire may be caused by various reasons – gas leakage blast, chemical explosion, electricity exposure and so on. Here, the death caused by different means of fire is explained by a second-order polynomial relationship. The value of R^2 is low to the extent of 36.57% that suggests for a very weak interrelationship among the data to explain any trend.

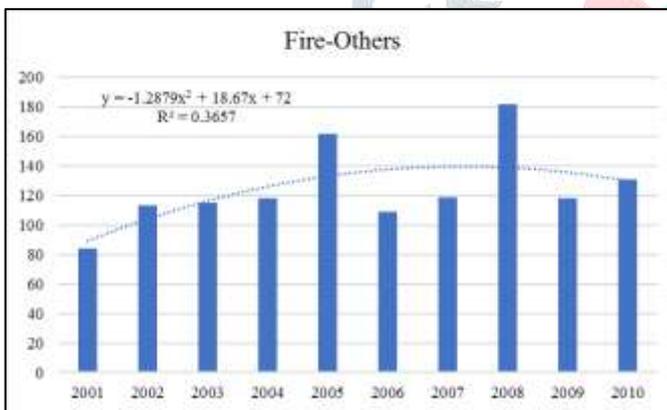


Figure 4 Deaths in Surat due to Fire (reason others)

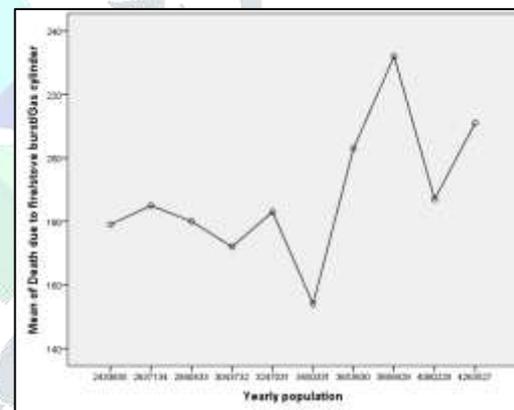


Figure 5 Population and deaths caused by fire relationship

With an average death of about 125 persons each year due to fire hazards (of another category), the total death of 1,251 persons is recorded in the study duration. The cause of the fire has a contribution of 4.28% in total un-natural deaths in the city for the duration of 2001-2010.

Here, the rise in the population does not show much of significant dependencies with the deaths caused due to fire hazards in the city. The uneven trend observed for the deaths recorded with a reason of caused by fire, may not lead to further investigation in exploring correlation with the rise in the population.

An analysis of records of past 10 years (i.e. 2001-2010) suggests that,

- The increase in the population per year has a positive relationship with total deaths in the city due to unnatural causes.
- The correlation between population and the total un-natural deaths is reliable to the extent of 0.945 (Pearson's coefficient) with a value of $p < 0.05$.

IV. RESCUE OPERATIONS BY SMC

The Surat Municipal Corporation (SMC) has established about 14 fire stations within the city limits of about 327 km². These stations are mandated to serve the entire population of the city as well as in the surrounding localities in the vicinity as well. In the light of severe events taking place locally, in various parts of the city, the Fire & Emergency Department of the Surat Municipal Corporation has witnessed several calls asking rescue services. The graph shown in the figure below is a graphical representation of the calls received. The average of rescue calls received by the SMC is crossing a number of 3,031 per year for past seventeen years i.e. almost 8 calls per day. A total staff deployed for the services by the SMC is reported as 1,001 persons (Surat Municipal Corporation, 2018) that include technical and non-technical persons. These employees are stationed in a distributed manner on each of the fire-stations.

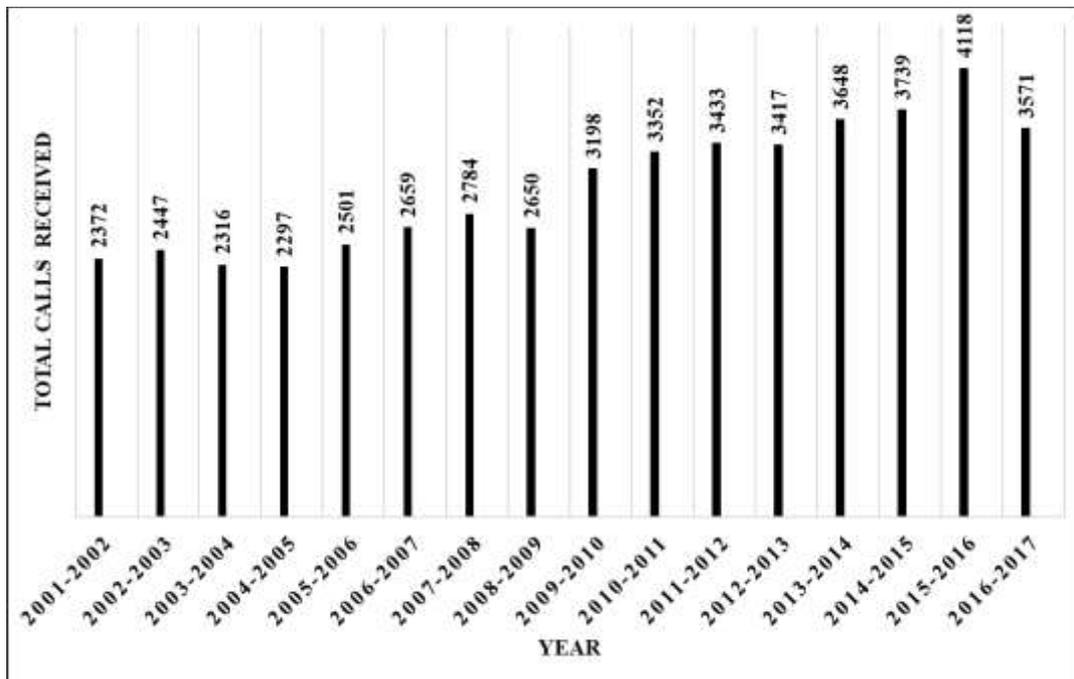


Figure 6 Calls received for rescue services by SMC
(Source: Surat Municipal Corporation, 2017)

V. WEATHER ANALYSIS FOR SURAT

The records obtained from the Indian Meteorology Department are used to analyse various components of environment like temperature, wind speed, and so on. All these components have significant effects on day to day life. After the data collection of past 20 years of data of Surat city shows a specific pattern of the weather.

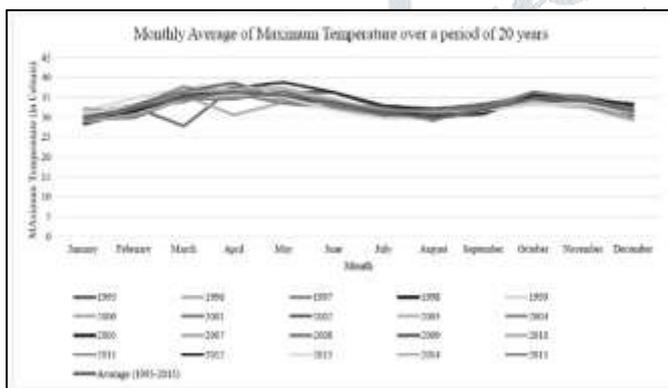


Figure 7 Monthly average of temperature

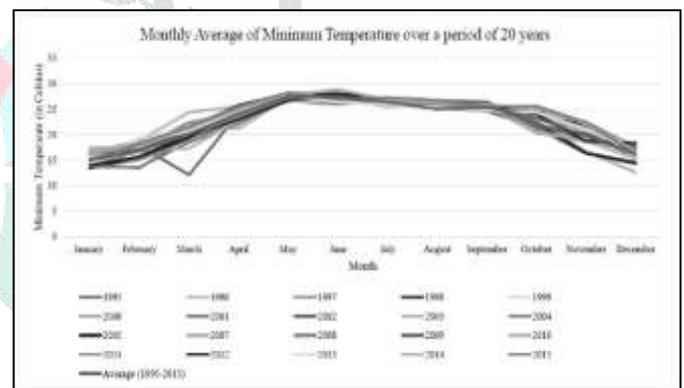


Figure 8 Monthly average of minimum temperature

The above graph (Fig. 7) shows the average maximum temperature of each year from 1995-2015 with a reference dotted line of average maximum temperature over a period of 20 years. It can be seen that due to global warming, the avg. maximum temperature has risen in summer and dropped in winter since last few years resulting in increased hazard probability. The years of 2013 and 2014 mainly shows a drastic drop of about 8 °C from the average maximum temperature.

The average minimum temperature too has risen in winter and dropped in summer for each month over the course of 20 years when compared with the average minimum temperature. In this case, too, 2013 had comparatively quite a cold winter and hot summer compared to other years. From both the graphs (Fig. 9 and 10), global warming has resulted in a high change in temperature. These temperatures are compared with the rainfall and wind speed during that year.

The rainfall is observed in mainly from June to October. The frequency of rainfall is high in June to September (Fig. 11). Other months are rarely observed with rainfall. The above graph (Fig. 12) shows the average of wind speeds in km/hr over a period of 20 years.

As expected, the rainfall has a direct effect on the wind speeds, and hence the wind speeds are the maximum in Monsoon Period. A cyclone generally resulting in high wind speeds can cause significant falling of trees and damage to human life and property and hence, it is of concern to the emergency operation centre. As expected in a tropical country, the majority of rainfall in Surat city has been in the month of June- September. There had been a devastating flood in 2006, but the rainfall record says that the total rainfall achieved in 2006 was less than the rainfall in other years. But since the rainfall in other areas in the upstream of Ukai Dam serving Surat City was high, and the water was not released on time from the dam, it resulted in the flood in the city.

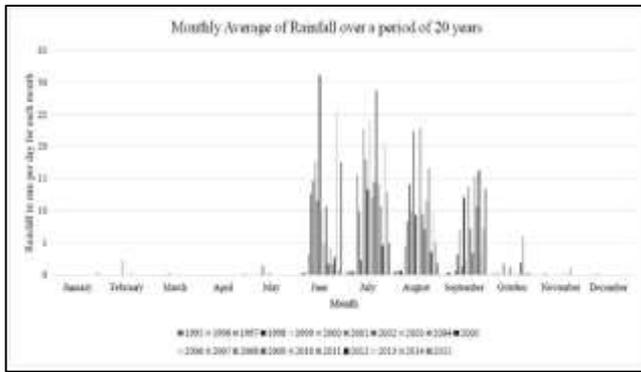


Figure 9 Monthly average rainfall of past 20 years

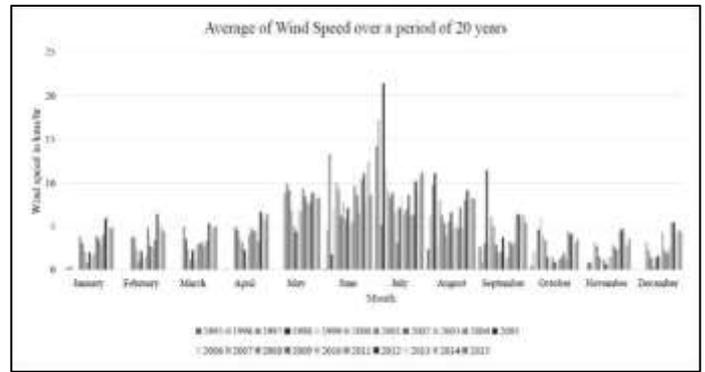


Figure 10 Average wind speed

Hence, a calamity can be avoided if a Proper Emergency Operation Centre is present in the city. It can be seen that Surat receives more than 70% of its rainfall in June-July making it the most critical for future analysis of rescue works.

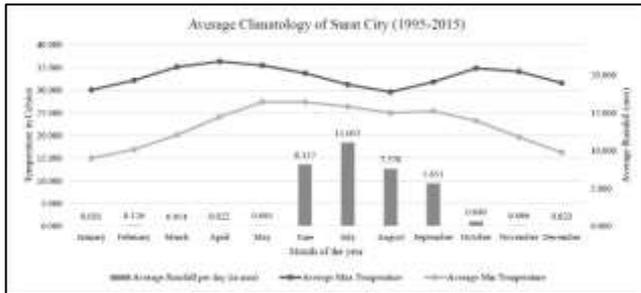


Figure 11 Average climatology

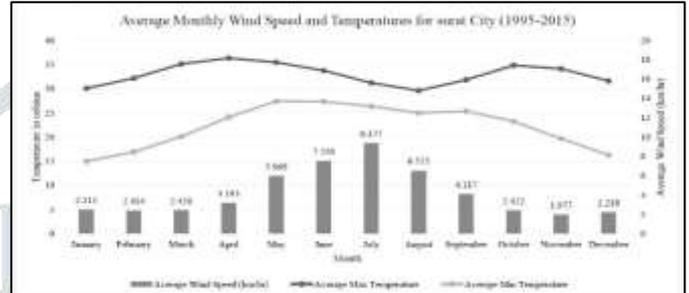


Figure 12 Average Wind speed and temperature

The above graph shows the average climatology of Surat City (Fig. 13). It can be seen that there is a high range of max and min. the temperature during winter which gradually decreases when the summer approaches and is the lowest during monsoon. During this low-temperature difference, the rainfall is the maximum keeping the temperatures uniform. However, with increasing deforestation, this temperature difference is continuously rising and is going to be a concern of a calamity for Surat city.

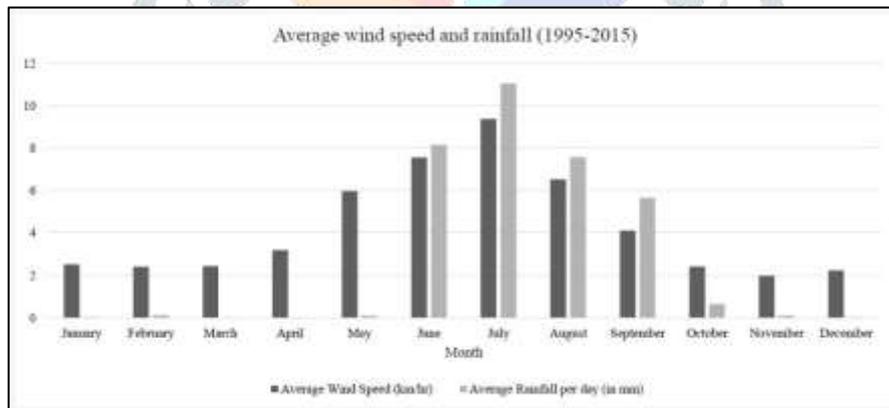


Figure 13 Average wind speed and rainfall

The relation between rainfall and wind speed shows that an increase in rainfall has a direct influence on the wind speed as discussed earlier. This effect has a significant influence when both a high increase of rainfall and wind speed coincides. Such conditions of probable floods and cyclones, if not prevented, can result in devastating effects for the city and can even lead to hundreds of deaths of people and animals.

VI. NEED FOR AN EOC IN SURAT CITY

Surat is prone to many natural and manmade disasters like floods, earthquake, fire, chemical incidents, war, stampede and so on. These disasters leads losses of human and infrastructure. During emergencies gathering information, decision making and directing necessary actions require close coordination among government officials. It also is promoting to make strategies and disaster management plan. For this purpose, in every city or district, the provision of an Emergency Operation Centre (EOC) is essential. An EOC and its sub-centres can be planned based on the intensity of the disaster that can occur in the particular area. EOC consists of many components, and there are several levels. The size of the EOC may differ according to the size of the response system required. It acts as a critical component of Emergency Management (EM).

The information of fire and flood shows the significant need for a virtual or physical EOC for natural as well as man-made hazards in Surat city. There is also the need of studying the weather pattern of the city to correlate it with various factors and to decide the strategies emergency management. For better operation and implementation of emergencies, EOC and its sub-centres are required in Surat city.

5.1 DISCUSSIONS

The paper discusses the results of correlation analysis among particular parameters as well as a regression analysis that explains the dependencies of parameters to the increase in the population in the past decade. The decade is considered the duration of the year 2001 to the year 2010 as per data availability. Surat is one of the fastest growing and rapidly expanding cities among the Asian urban centres, and the city has geography that contains low-lying areas prone to frequent flooding. Similarly, citizens die due to other un-natural causes as well. However, significant causes were identified as fire/gas stove bursts. Average annual deaths due to fire hazards were recorded as 188 for the decade under study. Based on the correlation, it was also identified that the extent of un-natural deaths is increasing along with the increase in the population; coefficient of correlation was observed to be high for un-natural deaths.

VI. CONCLUDING REMARKS

During the time of emergency, it is necessary to respond at a city level by coordinating with the organizations such as fire department, police department, crisis management team and local governing authority. These teams have specific needs but their technology, as well as financial support, is limited. So, to respond in better and planned manner, the EOC should make provision at a city level. As the past record of many Indian cities shows that there had been emergencies like earthquakes, floods, epidemics, and typhoons which leads the citizens in difficulty and leads to the loss of life as well as the infrastructure of the city. So, for better emergency management a state-of-the-art EOC should be constructed and made operational in Surat city that may come up with better disaster management plans and strategies.

ACKNOWLEDGEMENTS

The authors are grateful to SMC officer Dr Rajesh J. Pandya (Deputy Commissioner-North zone), Er. C. Y. Bhatt (Deputy Commissioner – South-east zone), Er. Ketan S. Patel (Fire and emergency services), of Surat Municipal Corporation for their valuable time and advice for the work. The authors are also thankful to Dr Vaishali Mungurwadi, Principal and Prof. (Dr.) Pratima A. Patel, Head of the department, Faculty of Civil Engineering, Sarvajani College of Engineering and Technology. Especially thanks are express to all faculty members of Town and Country planning department of Sarvajani College of Engineering and Technology.

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