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Emergency Evacuation of High Rise Building by Escape Chute Technology

Chetan G. Joshi [#1], Pritee S. Surate [#2], Sheetal R. Shirsath [#3], Prajwal R. Suryavanshi [#4], Tejashree R. Tarte [#5], Sonali R. Khairnar [#6]

1. Assistant Prof. Department of civil engineering, Guru Gobind Singh College Of Engineering And Research Centre
2,3,4,5,6. Student Department of civil engineering, Guru Gobind Singh College Of Engineering And Research Centre

Abstract
This paper is on the study of escape chute system. In this paper we describe the types, benefits, limitations of chute assembly. The motto of this paper is rapid evacuation of people from high rise building and many other structures like automobile etc at the time of emergency using these chute escape systems around 400 lives' can be saved within 15-20 minutes. For the convenience and safety of people this system is specially made device offers a fire-proof, high temperature-proof and multi entrance passage for collective escapes at the same time. Nowadays the chute devices for escaping in high rise building become important for collective escape, which is easy to use and runs at high speed without extra power. This paper presents the developments in the area of the high-rise building emergency evacuation solutions. Discussed about the need of such devices. This equipment can release escape chute and bring evacuee more safety and escape efficiency. This paper shows why this system is more convenient for the evacuation. This paper highlights all the points why people can rely on this system for safety and which will give them more mental support and peace of mind. Through this paper we have tried to inform all the people about the biggest factor which we have to concern during construction is 'Safety'. This paper focuses on how one individual can use this system at the time of emergencies.

Keywords: *Verti-Scape Escape, Single-Entry Escape System, Multi-Entry Escape System.*

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I. Introduction

Background of the Escape Chute is an evacuation chute that allows people in high-rises and other tall structures to safely slide vertically down to the ground. The chute has a three- layer construction made up of technical fabrics that protect users from flame, heat and smoke

Although some early escape tubes were made entirely of metal, most current designs are made of high-strength fabrics, such as Kevlar. Their flexibility allows for compact storage, rapid deployment, and a gentler braking and controlled descent of users, as compared to traditional metal designs. Fabric tubes may also incorporate inflatable elements to lend some degree of structural rigidity and stability to the escape chute. The fabrics chosen must have flame retardant properties as well.

In addition to fixed escape chutes permanently installed onto buildings, mobile escape systems are produced which can be mounted on the basket of a movable fire truck ladder, or temporarily installed to a building in an emergency.

In response to images of trapped office workers in the September 11 attacks, personal escape devices for emergency use have been proposed, but only rope-based systems appear to be on the market for personal use.

There was also the issue of fire heating the metal tubes, causing the people inside the metal tubes to become severely burned while exiting the building.

II. Objectives

1. Intended to provide occupants with an alternate evacuation route that is only to be used as a last resort during emergency situations if the primary routes of egress are unavailable, overwhelmed or obstructed, in any way.
2. To increase the capacity of a building's means of evacuation –can be used to accommodate timely full evacuation of occupants.

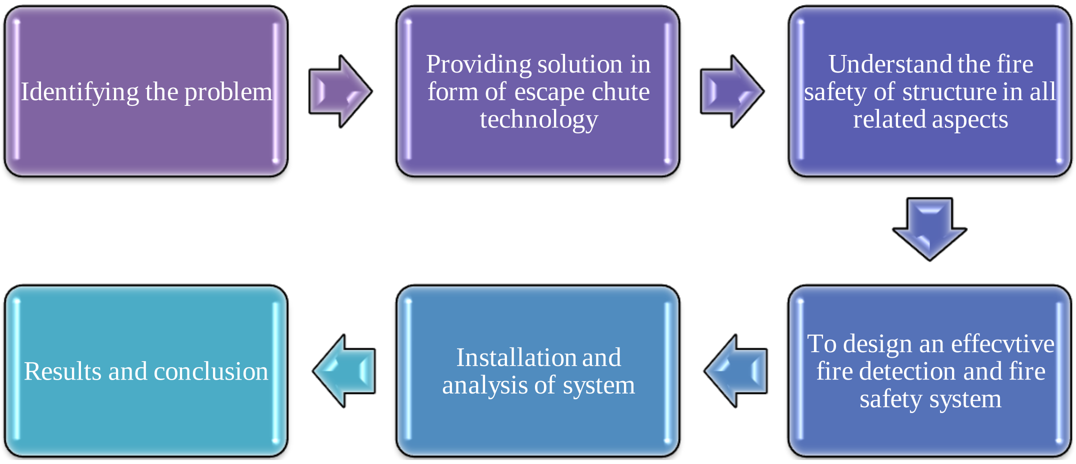
3. To ensuring evacuation system when the stairs and elevators are not passable or damaged, gives trapped individuals the chance to make their escape from a building in the critical minutes before rescue services arrive .hence the remoteness of egress components.
4. Identify the key behavioral factors affecting the performance of people during a fire in a high-rise building, the singularities associated to this type of buildings and areas of future research.
5. Review the procedures and strategies currently adopted in high-rise buildings (e.g. horizontal and vertical evacuation methods, phased evacuation, total evacuation, defend-in-place, etc.).
6. Review and analyze the capabilities of evacuation models by reviewing their current characteristics and applications in the context of high-rise building evacuations.
7. The intended target audience of the review is all parties involved in the design and performance of high-rise building evacuation systems, such as fire safety engineers, architects, fire officers, etc. The present work addresses the absence of a review dedicated on the use of evacuation models and the study of human behavior in high-rise buildings.

III. Methodology

To achieve a well-designed egress plan, egress time calculation is thus essential. Initially, we need to find a tool to carry out the computation with all the architectural and structural input of that building. Basically, egress time calculation results can be attained either by manual calculation, or complex computer simulating models. In this section, we begin with the determination of our desired output, so to speak, what kind of results we want to achieve after the calculation. Next, an appropriate calculation tool will be chosen to fulfill these output requirements**.** To date various methods have been developed and introduced to calculate the theoretical egress time in emergencies. Calculation of egress time is a process from simple to complex, decided by how many factors we want to achieve in the end**.**

Table 3.1 – Factors affecting effective evacuation

Sr. No.	Factors affecting effective evacuation
1	Fire location
2	Fire and spoke spreading speed
3	Route choice
4	Disabled agents
5	Impact on agents familiarity
6	Movement
7	Compartment dimension
8	Total length of route
9	Use of lift /elevator



Methodology

IV. Types of escape chute

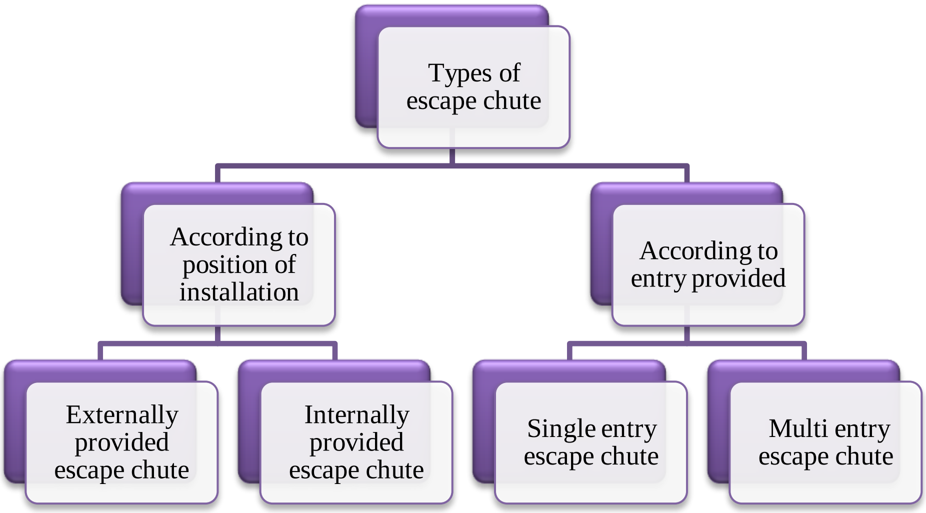
1. According to position of installation

i. Internally provided escape chute

This type of escape chute provided at interior side, or inside of building constructing a small cubical room and installing the escape chute inside the room. This type of chute may be single entry or multi entry having connected at each floor.

ii. Externally provided escape chute

This type of escape chute provided at exterior side, or at outer side of building constructing a small balcony and installing the escape chute in balcony. This type of chute is found to be single entry.



Types of escape chute

2. According to entry provided

i. Single entry escape chute

The Single-Entry Chute is a system that has been designed for Individual Offices, Homes or Building which do not have a vacant duct or shaft. The Single Entry Chute can be installed on any convenient Window, Gallery or Terrace. This is also an ideal solution for providing an Evacuation System for Existing Buildings where a duct is not available and an Evacuation system is found to be necessary. The Chute could be installed quite easily on the existing Refuge Floors to provide an Evacuation Path in case of an escalation of the Emergency Situation or for the Evacuation

ii. Multi Entry Escape Chute

Multi Entry Escape Chute can be entered at various floor levels, but still has only one exit point. Single Entry Systems are generally installed onto the roofs or through walls, windows and off balconies of buildings, and are deployed on the outside of the building. Generally, escape chutes deployed outside of the building have a height limit of around 120meters or 50 floors.

V. Benefits

1. Rapid and safe evacuation
2. Possible evacuation of more than 15 people per minute
3. Equally suitable for handicapped, unconscious people, infants and pregnant ladies
4. Height of 100 meters and more is possible in a single chute
5. Confirms a controlled, stable and smooth sliding process
6. All escape chutes over 15 m are equipped with a ground anchor to resist wind movement
7. The Escape Chute is delivered with a 15-year guarantee based on annual maintenance

VI. Limitations

1. Expensive system
2. Cannot be directly used by children less than 10 yr. old.
3. Difficult to install multi entry escape chute in existing structure.
4. Increases the economy of the construction

VII. Test conducted

1. Testing of Aramid Fiber Reinforced Polymers

U.V. test

2. E -Glass fiber testing

Tensile Test

Compression Test

Flexural Test

Impact test

VIII. Results

1. Aramid fiber

Table 8.1.1- Experimental results for peak load

	0 HOURS		200 HOURS		400 HOURS	
	A	B	A	B	A	**B**
Tensile	11621	12730	14592.8	10562.1	15485.2	8728.23
Compression	921.86	696.3	1971.207	608.034	951.279	519.771
Flexural	284.39	451.12	353.052	470.736	284.403	715.911

Table 8.1.2 - Compression strength for different hours of UV exposure.

	0 HOUR S		200 HOURS		400 HOURS	
	A	B	A	B	A	**B**
Tensile	225.65	203.848	293.89	174.832	293.838	143.852
Compression	76.715	24.893	61.699	19.790	54.838	15.613
Flexural	13.021	6.492	13.822	7.574	14.324	8.640

Table 8.1.3 - (A - Continuous FRP, B- Continuous and Discontinuous FRP)

	0 HOURS		200 HOURS		400 HOURS	
	A	B	A	B	A	**B**
Compression	76.715	24.893	61.699	19.790	54.838	15.613
Percentage	100	100	81.98	79.5	72.48	63.72

2. E-glass fiber

Table 8.2.1 - Tensile test

Sample no	Cs Area [mm^2]	Orientation	Peak load [N]	% elongation	Uts [N/mm^2]
1	85	30°	6312.112	12.08	26.013
2	85	0°	6412.002	13.523	28.223

Table 8.2.2 - Compression test

Sample no	Orientation	Cs area [mm^2]	Peak Load [N]	Compressive strength [N/mm^2]
1	30^o	120	6342.235	44.253
2	0^O	120	6452.223	46.221

Table 8.2.3 - Flexural test

Sample no.	Cs area [mm^2]	Orientation	Peak load [N]	Flexural strength (MPA)	Flexural modulus (GPA)
1	85	30°	258.125	26.32	46.001
2	85	0°	268.002	28.12	47.012

Table 8.2.4 - Izod impact test

Sample no	Orientation	Izod impact value in j
1	30°	12
2	0°	16

IX. Conclusion

The only significant means of evacuation from high-rise buildings and for access of rescue forces to higher floors have been the stairwells and limited use of elevators. Recent events, such as the 9-11 World Trade Center disaster and others, indicate that this is problematic and insufficient. Furthermore, it is clear that significantly improving the internal means of egress—especially in existing construction—can be prohibitively expensive and downright infeasible

Systems for external evacuation of high-rise buildings provide an alternate escape route and additional evacuation capacity. Some of these systems support emergency forces in accessing higher floors of a building – an advantage that can reduce significantly the time required to reach. Some of the systems are personal and are for immediate significantly the time required to and gain control of an event (such as fire) in the building and to help use by the tenants, without the need to wait for emergency forces, while other systems supply building-wide solution, with vary large capacity. Some have the ability to transport emergency responders and their equipments.

X. Future scope

1. Every escape Chute installation is designed to meet stringent requirements for safety, strength and reliability for aiding emergency egress, and has give substantive consideration to User safety, taking into account the emergency situations in which it would be utilized
2. Specific factors of the evacuation process in high-rise buildings need further studies.
3. One of the future recommended requirements for the evacuation research community is the study of the impact of fatigue on the evacuation process.
4. Given the increasing height of buildings and the gradual reduction in the physical ability of the population, this appears as a key variable that has been so far mainly ignored in evacuation models.
5. An important factor that also needs investigation is the effect of group dynamics in the evacuation process.
6. An important variable that needs to be enhanced in evacuation models is the possibility to explicitly implement the impact of the actions of staff on the evacuation process. In particular, there is a need to develop algorithms able to represent the effects of communications between agents.

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