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Glass Facade Water Cooling System

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Abstract - *Arguably, one of the most important requirement a building must meet in case of fire is the ensured and safe evacuation of its residents, workers , users and the work of rescue teams. Consequently, issues related to the danger associated with falling parts of glass façade panels are fairly well known in India. Because of its high delicate and aesthetic looks and ease of installation of glass façade panels are being immensely used for outer walls of modern structures. Defined usually as curtain walls they provide the perfect inner atmospheric control and adequate lighting for variety of facilities. But aesthetics comes at a cost during fire scenario under high temperature this glass facade panel fall due to tearing of sealant, melting of aluminium frame and the behaviour of glass panel under high temperature and in this document we are going to analyse a solution for this problem depending on the experiment conducted in Gandhi nagar located in Gujarat named as- Performance of glass-ACP façade system in a full-scale real fire test in a G+2 structure*

Key Words: **Fire fighting ,Glass facade, Radiator system, BMC guidelines, Working and Estimation.**

1. INTRODUCTION

The most important function of building during a fire scenario is to ensure the safety of its residents, workers , users and rescue teams. Therefore the risk related with the possibility of parts falling from the exterior glass façade panel in case of fire cannot be overlooked. For fire resistant façades, glazed with special glass panes this problem is arguably eliminated. In practice, more often, the fire resistance of the external wall is limited only to the spandrel areas, which allows the use of non-fire rated glass panes in the remaining space of the facade. This solution is sufficient to stop the spread of fire to adjacent floors of the building, but may pose certain risks associated with the possibility of large pieces of the façade falling. The problem is mainly related with the behaviour of glass units under the influence of high temperature (which is around 2600°C - 2900°) during a fire. Therefore ensuring the safety of evacuating users and rescue teams may also depends on the behaviour of specified glazed unit fixing and structure. It is assumed that if, under the influence of fire, the outer layer of glass unit will break up into small pieces and fall down, it poses no threat. In opposition, if glass unit falls off as a whole (or in large, heavy pieces) then the danger is substantial.

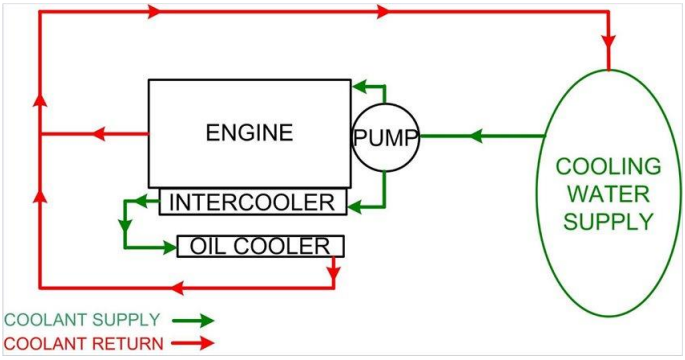
A major fire breaks out at 21st floor of lotus Business park building andheri, Link road this area is heavily crowded and one fireman was found dead in the multi-story building fire in Andheri. Fire brigade, Navy and costal guard personnel are fighting a serious battle to rescue firemen and users trapped on the terrace of 22-storey commercial building fired up in a western Mumbai suburb where two helicopters have been pressed into service to evacuate them.

A Municipal Corporation of Greater Mumbai (MCGM) official informed that around 15-20 fire fighters were able to move on the terrace. In this incidence the glass façade panels become a major problem for the fire fighters and fire officers, who were struggling to come close to the building to continue the rescue, while pieces of glass were falling from it. According to fire fighters and officials, ventilation was another major issue for fire fighters engaged in dousing the flames .Even the people standing below the structure had to move below the structure had to be moved from the area .we know that we urgently need to find sustainable solution for breaking and falling of glass facade under high temperature (fire scenario) But fortunately or unfortunately After several similar mishaps in the past , Brihanmumbai Municipal Corporation (BMC) drafted specific façade guidelines for building such as every high rise building with glass facade should have an opening and the laminated glass should have high quality to resist the heat.

But the question is what about existing structures having inferior quality of glass facade used in it and most important can high quality glass façade can really handle the high temperatures during fire scenario? The answer to this question may be yes or no but we should be ready with the solution and shouldn't be afraid to try new ideas.

1.1 Basic mechanism:

this system is based on water radiator used in automotive engines in which water circulates from the engine to the radiator, a system of fins and tubes with a lot of exterior surface area heat moves from the hot water to the radiator , causing the water to cool off in this way ,the engine heat moves out of the cooling system and into the surrounding air in case of building having glass façade we will use this mechanism to cool the glass façade panels in which water will work as a coolant and the glass façade will resemble automotive engine.



Technical Specification of equipments requires:

- For this system will require a water tank or separate water supply system which capacity depends on the surface area of building consisting glass façade.

- Hydraulics – this system will require a high pressure water pump which can generate pressure upto (15bars -20bars).

- Jockey pump – jockey pump will keep the system pressurized during normal non-fire conditions. Since the activation of the large flow main fire pump is triggered by a system pressure drop. It is important to maintain system pressure since even normal plumbing leaks allow the system pressure to bleed down over a period of time. When the system pressure drops to a present level, the jockey pump starts and charges the system back to normal pressure. Addition of jockey pump will depend on application of dry rise system or wet rise system

- Hose/Pipe system – For this system copper pipes are recommended as they are good conductor of heat and thus copper pipe will absorb the heat from the water flowing over the glass panels and distribution pipes

1.2 Working-

1. In this system in the case of fire scenario the information regarding the location of fire and its class gathered with the help of smoke detectors and the water from the overhead tank is allowed to fall over the top most raw of glass façade panels evenly with the help of distribution pipes.

2. The water flowing over the glass panels keeps the temperature of glass panels under control and acts as a cooling agent in case of building with height less than 35 meters we can add polymers which are known to cover more surface area effectively and good absorbent of heat.

3. Then this water is collected near the bottom most raw of the glass panels with the help of collecting pipe.

4. Collected water from the collecting pipe is then diverted towards the hydraulic pump having pressure 15bars-20bars.

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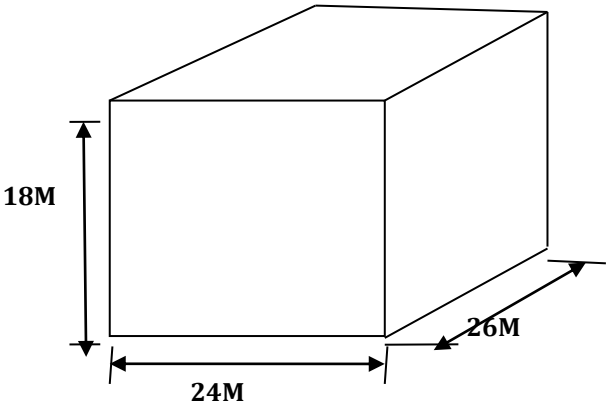
6. This cycle is continued over and over again to keep the temperature under control until the fire is fully extinguished.

2. ESTIMATION



Considering a building having a surface area covered by glass façade panel :-

Total surface area covered by glass façade panel-

=864+936

= 1800Square Meter

1. Volume of water required to cover the entire area of glass façade panels-

=NO. OF SIDES* SURFACE AREA* THICKNESS

= {2*(18*24)*0.05} + {2*(18*26)*0.05}

= 90 m^3

Total Volume Of Water sliding Over Glass Facade Panel=90000 liters

2. PUMP SPECIFICATION:
No. of pumps = 2

Hp = 170 H RPM = 3800

Impeller Diameter of pump = 280 mm.

vane angle = 30°°, impeller diameter = 280 mm, outer width =50 mm, manometric efficiency =95%

Hm = 18m

N =3800rpm

Vane angle = 30°°

D2 = 280 mm

B2 = 50 mm

Efficiency =95% =0.95

1) Tangential velocity of impeller at outlet

$$U2 = (\pi DN)/60 U2 = (\pi DN)/60$$

= (π×0.28×3800) /60

=55.76 m/s

2) Ηman =(g×Hm) / (Vw2×U2)

0.95 = (9.81×18) / (Vw2×55.71)

Vw2 = 3.33 m/s

2) tan ø =Vh2 / (U2 –Vw2)

tan 30°° = Vh2 /(55.71-3.33)

Vh2 =30.24 m/s

Discharge = Q = $\pi \times D^2 B^2 \times Vf_2$

= π×0.28×0.05×30.24

Q = 1.33 m^3/s =1330liter/sec

Copper Pipe-

Volume of water held by the copper pipe = π r h

(ø =20 cm) = π × $(0.2/2)^2$ ×18

= 0.565 m^3

= 565 liters

3) (Frictional losses in pipe = 0.083 m)

Spec. gravity of water = 800 kg/m^3

Volume of water = 0.893 m^2/s

Rel =(U×L)/V

= $(7.388\times10^{-3}\times18)/ 0.893$

= 0.0148

$C_D = 1.328/\sqrt{Rex}\sqrt{Rex}$

= $1.328/\sqrt{0.0148}\sqrt{0.0148}$

= 10.91

$F_D = 0.5 \times\rho\times A \times V^2\times C_D$

= $0.5\times800\times18\times100\times(7.388\times10^{-4})^2$

F_D = 4.28 N

Friction Drag = 4.28 N

4) Assuming the water quantity required to cover the glass façade panel = 90000 lit

+ water held by copper pipe = 565 liter

+ (frictional losses in pipe + water flowing over glass plate) = (0.083+4.28)

Therefore, Providing = 95000 lit. Water Tank considering all the losses & Cavication of Centrifugal pump

3. CONCLUSIONS

As we have discussed earlier Brihanmumbai Municipal Corporation (BMC) drafted specific façade guidelines for building such as every high rise building with glass facade should have an opening and the laminated glass should have high quality to resist the heat.

But the question is what about existing structures having inferior quality of glass facade used in it and most important can high quality glass façade can really handle the high temperatures during fire scenario? The answer to this question may be yes or no but we should be ready with the solution and shouldn't be afraid to try new ideas . and this is small innovation from our side which can cool the glass façade panel under high temperature during fire scenario for safe evacuation and mainly focuses on the existing structures having glass façade panels which are not ready to replace whole glass façade system with new

high resisting glasses, Further improvements in this system can be done by addition of fast heat absorbing and releasing material in circulating water.

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