

Glass Façade Breakage by Explosive Shock Wave Induced By Meteorites

W.K. Chow

Fellow Elected, Hong Kong Academy of Engineering Sciences

Research Centre for Fire Engineering, Department of Building Services Engineering

The Hong Kong Polytechnic University, Hong Kong, China

1. Background

As reported in the news [1-7], a powerful meteorite explosion occurred in the sky above the Chelyabinsk, a Russian city with a strong presence of military and nuclear waste industry, on 15 February, 2013. According to the news report [3], the meteorite caused a sequence of explosions in the skies above the Urals region. A bright flash was witnessed in the Chelyabinsk, Tyumen and Sverdlovsk zones, as well as in the Russian Republic of Bashkiria. The impact of the explosions shattered the windows of many homes [3]; many houses juddered and the signals of cellular network were affected in three Russian cities.

The meteorite might explode due to two reasons as reported in the news [1-7]:

- The explosion of gas inside the meteorite could be triggered by the heat generated while the meteorite travelled through the atmosphere.
- The meteorite was supposed [3] to be detected by an ‘air defence unit’ at the Urzhumka settlement near Chelyabinsk. A missile volley reportedly crashed the Russia meteorite at an altitude of 20 km.

This was the second time that a meteor hit the Chelyabinsk region of Russia [5]. In June 1949, a meteor called ‘Kunashak’ landed in the area. About 20 pieces of total weight of about 200 kg were found for that incident. Locals claimed that [1-7] a fragment of the meteor had fallen in the Chebarkul Lake. However, its debris or known as ‘Kunashak’, has not been found in the lake yet.

2. Areas of Concern

No doubt, the direct impact of the meteorite on the ground will be very powerful, and it can result in serious damages [1] like the Tunguska incident in Siberia in 1908. The Russian

meteorite explosion [1-7] induced serious consequences: glasses of 200,000 m² area were broken [6]; a shock wave was generated. . This incident has raised the alarm in dense urban cities like Hong Kong, where tall buildings with glass façade are commonplace. There are two points of concern in case large quantities of glasses are shattered:

- Fast moving fragments broken from big glass panes would cause serious damages. As observed from the video, small glass fragments might have high momentum to damage items stored inside.
- A small room fire started in a tall building with broken façade can be intensified [8]. In a residential building, high air intake rate can burn the stored high amount of combustibles with fire load density up to 1400 MJm⁻² [9].

3. Any Remedial Work?

The incident [1-7] certainly raises the alarm on the possible risks of meteorites. In small places like Hong Kong, nothing much can be done, as it is impossible to develop ‘air defence units’ to strike the meteorite at a high altitude. However, it is worthwhile to consider the use of glass façade for new projects carefully. The government should also work out contingency plans on evacuation, rescue and firefighting in case of a large-scale glass explosion. Supertall buildings with glass façades should be closely monitored.

References

1. “Powerful meteorite explosion in the sky over Chelyabinsk”, Posted by DeIntegro in Nature, Video, 15 February 2013.
<http://russiatrek.org/blog/nature/powerful-meteorite-explosion-in-the-sky-over-chelyabinsk/>
2. “Meteorite damages 3,000 buildings in Chelyabinsk” by Aleksandras Budrys, 15 February 2013.
<http://themoscownews.com/russia/20130215/191240594.html>
3. “Russia meteorite crash in Chelyabinsk wounds dozens, disrupts net services” by Marion Dean, 15 February 2013.
<http://www.globalnewsdesk.co.uk/europe/russia-meteorite-explosion-chelyabinsk-urals/03355/>
4. “Meteorite Impact!! Chelyabinsk, Russia and Farmville, NC” by Christacker, 15 February 2013.

<http://naturalsciencesresearch.wordpress.com/2013/02/15/meteorite-impact-chelyabinsk-russia-and-farmville-nc/>

5. Russian meteorite crash: LIVE UPDATES, 16 February 2013.
<http://rt.com/news/russia-meteor-meteorite-asteroid-chelyabinsk-291/full/>
6. Ming Pao Daily News, “世紀隕石空爆強如 20 原子彈 大如巴士原重 7000 噸釀 2.6 億元損失”, p. A15, 17 February 2013.
7. Yazhou Zhoukan, Vol. 27, No. 9, 3 March 2013 – In Chinese.
8. C.L. Chow and W.K. Chow, “Heat release rate of accidental fire in a supertall building residential flat”, Building and Environment, Vol. 45, No. 7, p. 1632-1640 (2010)
9. Ove Arup Hong Kong, Research in East Asia, Arup research brochure, December (2010).

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