# FALL PROTECTION: FROM ROOFTOP SNOW REMOVAL TO GENERAL WORK ACTIVITIES AT HEIGHTS

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ABSTRACT: The heavy casualties inflicted by the 2005 and 2006 snow storms prompted the need to establish the rooftop snow removal safety association to broaden safety awareness in rooftop snow removing activities. Since its establishment, the organization has helped advance the research, development and validation of fall protection devices not only for workers involved in rooftop snow removal, but also those who need to work at height. This presentation will outline some of the main activities as well as developments of work-at-height safety system carried out by the organization; it will also provide a brief overview of a few safety products developed as auxiliary devices to the safety system. Light and compact full body harness, plus a few recent safety devices will also be introduced.

## Background

The Rooftop Snow Removal Safety Association (in short 'ROSRESA') was established in response to the call of Midori Anzen president Mr. Matsumura for Japan's safety industry to do more to protect individuals from accidental falls while they work on rooftop – after the report of heavy casualties caused by the massive snowstorm in 2006 (152 fatalities, 2105 cases of serious and minor injuries). ROSRESA currently has 14 member companies and has been operating since June 2006 as one of the entities under the non-profit organization JSAA (Japanese Safety Appliances Association).

## The Beginning

One of ROSRESA's initial missions was to gather Japan's safety industry members to discuss and recommend the best possible safety solution for protecting those involved snow removal work. As the participating members have never worked collectively to create safety solution for general users, they decided to start by talking to local organizations and entities (in areas of Niigata prefecture, Tokamachi city and Minami Uonuma city) involved in snow removal activities. From the discussions, ROSRESA noticed that (a) rooftop snow removal in Japan snowy residential area is generally done by older individuals, and (b) the work is often done alone by these individuals without any fall protection measure in place.

In Oct that same year, two important annual safety exhibitions were held in Japan bringing more limelight on the safety issue for those who need to work at height. The first exhibition was Japan's annual biggest safety show 'The Green Cross Safety Expo' held in Niigata, and the second one was the JCOSHA (Japan Construction Occupational Safety and Health Association) convention held in Sapporo. As both exhibitions featured fall protection theme, ROSRESA seized the opportunity and exhibited its demos of simulated rooftop operations with relevant fall safety devices. At both events, ROSRESA also conducted survey to broadly collect comments on fall safety needs from those who are involved in rooftop operations. These collected comments later served as valuable data for ROSRESA to research on fall protection solutions.

**Figure 1. (Left) Exhibiting demo of simulated rooftop operations and devices. (Right) Experimenting on actual rooftop.**

Riding on a tide of positive user responses at the two safety exhibitions, ROSRESA quickly carried out multiple experiments on the installation as well as application of fall protection devices in simulated environment, using its laboratory on loan from Niigata prefecture (located at Shiozawa district of Minami Uonuma city). However, the low amount of snowfall in 2007 failed provide an adequate testing environment to validate ROSRESA fall safety devices .

It should be mentioned that from the get-go, the prefecture of Niigata has been very supportive to ROSRESA's initiatives. Apart from the Shiozawa laboratory, Niigata offered an additional experiment laboratory for ROSRESA to conduct its various fall safety experiments. This additional facility sits conveniently behind the Etsugo Yuzawa station, providing even easier access to users than the Shiozawa laboratory. When initially open, the Etsugo Yuzawa laboratory was not brought to its full utilization capacity due to low amount of snowfall that year. Despite this, ROSRESA did not slow down and continued to make progress in its fall safety research and initiatives. The uninterrupted developments paid off and helped ROSRESA bring the Etsugo Yuzawa laboratory to its full capacity in 2010. Some of the experiments performed at that lab were: 1) Elevator Ladder (ladder with small steps), 2) Lifeline and rope grip, safety block, 3) Body harness and safety belt, 4) Anchors, 5) System that enables lifeline installation from the ground level. Through tireless experiments and validations, ROSRESA was able to make many improvements upon its fall safety system. In February 2012, ROSRESA the system and featured it in its catalog widely distributed to various local labor authorities and entities that help draft safety standards.

## Fall Protection System for Rooftop Snow Removal (tentatively ' Rakubo')

The biggest characteristic of this fall safety system is its ability to enable users to deploy vertical lifeline on rooftop from ground level. Two of the main components of this system are Rakubo Stick and Pilot Line. When used together, they can help users safely put in place a 30-meter long (12 mm in diameter) vertical lifeline.

**Figure 2. (Left) Rakubo at work in rooftop snow removal. (Right) Rakubo stick, pilot line.**

## Weight of Snow as Anchor: Convenient and Eco-Friendly

The square-shaped anchor plate (approximately 50 cm in length on each side) uses the same

material as the safety belt to hold the snow. As such, it can withstand up 20 KN of force when burried in and weighed down by snow. Since the anchor uses only snow, this system is also arguably one of the eco-friendliest available. Aside from the anchor plate, ROSRESA has also developed a weight bucket to enable the use water or packed snow as anchor.

**Figure 3. (Left). Anchor plate. (Right) Weight bucket.**

From its experiments, ROSRESA has confirmed that snow weight of at least 50 kg is needed to create an anchor. Calculating the specific gravity of snow based on this confirmation, ROSRESA has determined that the anchor plate needs to be buried under at least 50 cm of packed snow in order for it to work as an anchor for stopping a fall. If packed snow is not readily available, frozen snow can also be used as anchor to produce sufficient fall arrest power.

## Looping Approach – Simple Lifeline Deployment without using Rakubo

A 30-meter long (12 mm in diameter) of eight strand plaited rope is used as the standard lifeline. By tying special loops and using them with carabiners, or using carabiners with the '8' rings, user can adjust the length of lifeline for safe anchor connection. Professional snow removal operators generally have a variety of devices (such as Rakubo, self-retractable safety block, rope grip, etc.) at their disposal to implement proper fall protection. However, in the case of general users, they often do not have the similar level of access or financial resources for fall protection devices. To help these users, ROSRESA has developed a loop-and-carabiner approach that can help user create a simple yet effective vertical lifeline for fall protection.

**Figure 4. (Left) Simple yet effective: loop on vertical lifeline. (Right) Deploying the lifeline.**

For houses with fixed ladders to their roofs (typically found in snowy areas of Japan), before the snow season begins, user can connect the top of the fixed ladder with the lifeline loop (or engage the hook/carabiner of the lifeline to the ladder-top) and suspend a vertical lifeline to the ground. The vertical lifeline must have a loop at each interval of 1.5-meter throughout its length. Once deployed, user can safely go up and down the ladder by alternately connecting the 2 hooks (or carabiners) from the lanyard of his safety belt D-rings. Combining the use of vertical lifeline, hooks/carabiners, lanyard, D ring and safety belt ensures that user is connected to the lifeline at any given moment when moving up and down on the work ladder. Once the on-ladder safety is secured, user can safely proceed to the center position of the rooftop and drop a 30-meter lifeline vertically down on both sides of the roof. On the ground, connect each end of the lifeline to an anchor to complete the vertical lifeline deployment. Naturally, before using this approach, the fixed ladder in use MUST BE first confirmed to have the strength to endure 11 KN of weight force as required by Japanese standards.

## The Stop Belt – Enabling Movements on Lifeline

The Stop-Belt is yet another innovative and economic way to help general users perform rooftop work safely; it provides user flexibility of movement while being connected on lifeline.

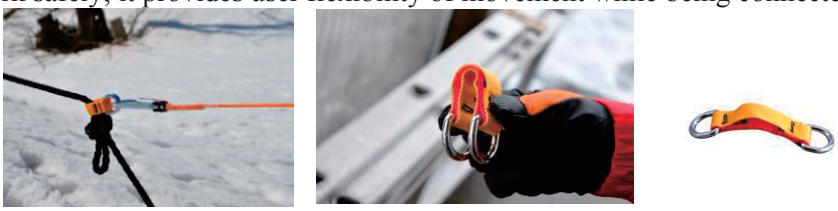

**Figure 5. (Left) Lifeline, stop belt and carabiner lanyard working as one. (Right) Stop belt.**

To use the stop belt, simply connect it to the lanyard hook of the safety belt (by engaging both of its end-rings with the hook to form a loop). After adjusting the lifeline loops to ensure proper fall arrest, user can freely slide the engaged stop belt between two lifeline loops. This enables broader range of movements on both sides of the rooftop to perform work. In addition, the scope of movements can also be adjusted by widening, or tightening, the distance between the lifeline loops.

## The Snow Removal Work Belt (with movable D ring) – Safe and Work-Adaptable

Due to its movable D-ring created to better facilitate operations, this device is not allowed by Japanese safety standards to be called a 'safety belt'. However, the item has been confirmed to possess the strength required by the Japanese standards to serve as a fall protection belt. If a fall should occur, the belt, working in conjunction with other falling protection devices, would stop a fall with its two thigh loop attachments (standard feature), and additionally securely keep the belt in its position preventing its accidental upward slip to user's chest or neck to endanger life.

**Figure 6. Work belt in action.**

## The Mesh Snow-light Work Harness - one of the lightest compact work harnesses

This is arguably one of the most suitable mesh work harnesses for general users. Due to its 25 mm wide webbing, this item is not allowed by Japanese standards to be called a 'safety harness'. However, similar to the 'work belt', this item has been confirmed to meet the requirement of Japanese safety standards and pack enough strength to function as a safety harness. It is also an easier harness to don on correctly than the already user-friendly Mesh Body Safety Harness.

**Figure 7. Mesh snow-light harness.**

## Specifications and Requirements Information Tag on Lifeline

Until now, there was no indication of the required product specifications on any of the lifeline products in Japan. This situation has often left user having to make an educated guess the product's replacement period and required strength. Noticing this, ROSRESA adopted a practice of tagging each of its lifeline products the required specifications and replacement time. Spelling out clearly such information on the lifeline product ensures that each item is adequate for its intended purpose and for how long. Information tagging is an extremely important step in any lifeline development process, regardless of the ultimate application of the product (rooftop snow removal or general work at height).

**Figure 8. Tag with specification info on product.**

## Safer Snow Removal Operations – Recognizing the Fall Protection Need

ROSRESA has been developing and proposing proper fall protection solutions to snow removal professionals as well as general users alike over several years. The organization has spared no effort to heighten public awareness of the danger in snow removal work conducted without fall protection. However, despite ROSRESA efforts, it will take time and further collaborations from various organizations - on both a national and local level - for the fall protection solutions proposed by ROSRESA to gain broader recognition. Support from local authorities and entities, including voluntary groups and community support organizations, is particularly crucial. This support can come in various forms - from the efforts of broadly educating the general users, to the actual practice of providing assistance such as subsidized purchase or rental of the necessary fall protection devices to general users – so that ideally each of them can implement proper fall protection before proceeding with any rooftop operations. Another influential factor may lie in the housing developers' broader recognition of the need for fall safety system, so that they can design houses in the future with features to facilitate rooftop installation of fall protection system. A broadened recognition in the society as a whole of the need for fall safety in snow removal operations is essential to help reduce the yearly accidental deaths and injuries caused by falls from work at height.