Development of Aerial Optical Cables with a Small Number of Fibers and Aerial Optical Closure for Connecting the Cables

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Abstract

We have developed aerial optical cables with a small number of fibers and an aerial optical closure in which these cables can be connected. They will reduce the investment required for aerial optical facilities to meet the wide-spread demand for FTTH (fiber to the home) services. Installing access points near customers' houses in advance will allow us to complete construction promptly when faced with sudden demands for FTTH.

1. Background

With the rise in the number of subscriptions to FTTH (fiber to the home) services such as the B-FLET'S service provided by NTT East and NTT West, there has been considerable investment in the construction of aerial optical facilities in recent years [1]. Aerial drop optical fibers and self-supporting small-diameter optical fiber cables have already been employed to meet the wide-spread FTTH demand, but the cost of these cables must be further reduced. In addition, as the amount of construction increases, we must find a way to shorten the construction time. We have therefore developed more economical aerial optical cables that contain a small number of fibers and a new aerial optical closure to accommodate these cables that is designed to be installed in advance at access points near customers' houses before service orders are received. In addition, we improved the existing aerial optical closure so it can handle the new cables (**Fig. 1**).

In our previous reports [1], [2], which dealt with the advanced technology of connecting cables and fibers, we described the advantage of using connectors. However, in this article, we focus on improvements to cables and closures without mentioning the methods

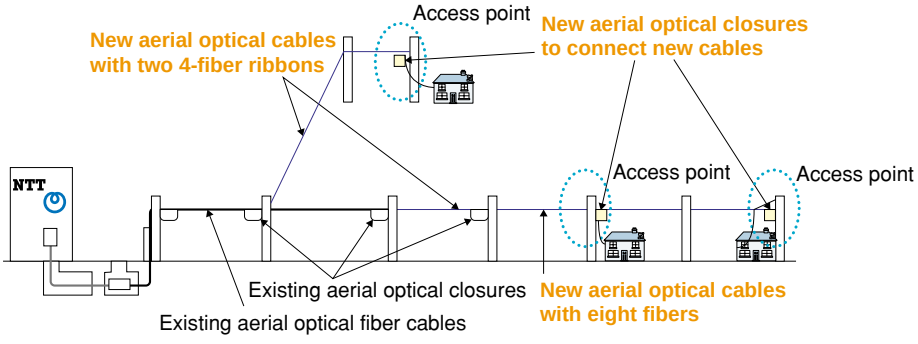

Fig. 1. New developments.

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of connecting cables and fibers, so the conventional connection methods are assumed here.

2. New aerial optical cables

Based on the following main requirements, we developed two new cable designs. One has eight fibers and the other has two 4-fiber ribbons.

(1) The cables must have an economical design.
(2) They must be self-supporting between telephone poles.
(3) Their fibers must be easy to extract with existing tools.

The new cables are compared with conventional ones in **Fig. 2**. Conventional 8-core aerial drop cable has eight elements each consisting of a pair of tension members and a 0.25-mm coated fiber. Each element is enclosed in a sheath. The messenger wire* in the center is also sheathed. The self-supporting small-diameter optical fiber cable has a pair of 4-fiber ribbons, which each has a nylon sheath, enclosed in a sheath. The new design reduces the cable cost not only by reducing the number of manufacturing processes and the amount of materials required by integrating the messenger wire and the cable along its length but also by directly covering the optical fibers (and messenger wire) with the sheath. To enable the cable to withstand the tension when it is hung between poles, we carefully chose the diameter of the single steel wire. We were concerned that the fibers might be difficult to extract, especially in the cable with eight fibers, which has a tight structure due to the optical fibers being directly covered with a sheath. However, we successfully devised the arrangement of each fiber in the cable and optimized the load exerted by the sheath on the optical fibers in the cable. As a result, the new cables have a lower cost, weight, and diameter than conventional cables.

* Messenger wire: a steel wire that takes up most of the tensile load when the optical cable is installed and hung on the pole.

3. New aerial optical closure

The requirements for the new closure were to be small and as light as possible to make it economical, to reduce the tension in the messenger wire, and not to appear unsightly. The conventional closure needed to be a certain minimum size because it had to accommodate extra lengths of optical fibers for cutting and splicing after the cable was installed. To enable the new closures to accommodate extra lengths of optical fibers, we partially detached the messenger wire section from the cable and cut off the messenger wire for

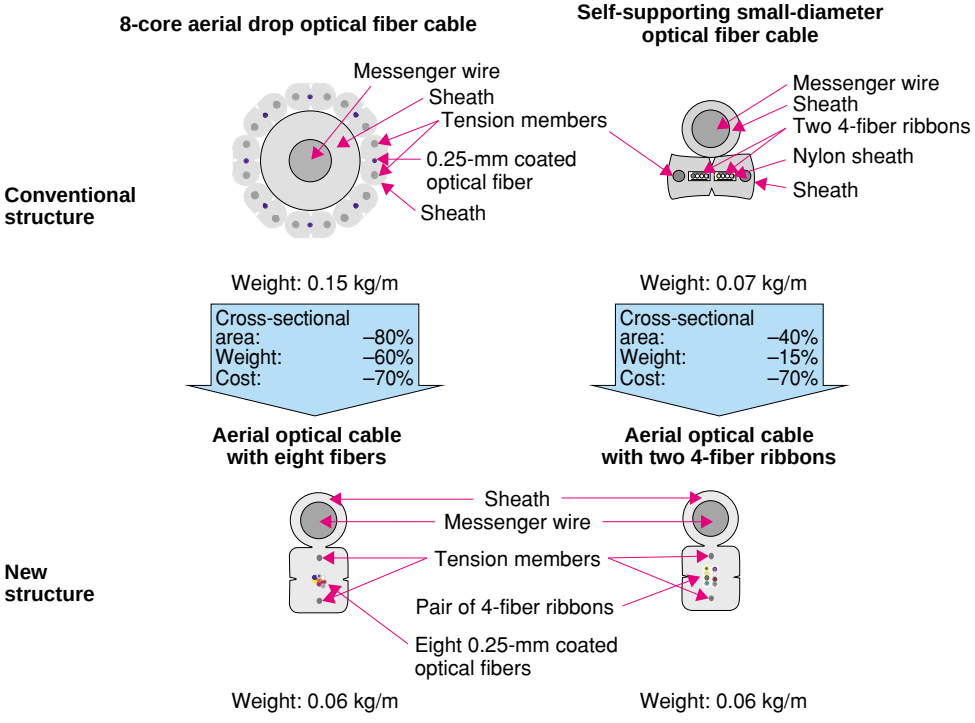


Fig. 2. Cross-sectional views of optical cables with a small number of fibers.

the length corresponding to the extra length of optical fibers. The extra lengths of optical fibers thus obtained can be stored compactly in the closure, so we were able to reduce the size and weight of the closure (**Fig. 3**). Moreover, the new closure enables optical fibers to be connected toward the terminal side so that another customer on the terminal side can use a fiber when a customer cancels a service order, because the new closure can accommodate longer extra lengths of optical fibers than the conventional closure. As a result, we also achieved a substantial cost reduction.

Installing these new closures near customers' houses in advance will allow us to complete construction promptly at reduced cost when faced with sudden demands for FTTH.

As **Fig. 4** shows, the closure contains eight fiber-pass trays that accommodate optical fiber passing through the closure to the terminal side and six drop trays to accommodate optical fiber to be dropped to customer's houses.

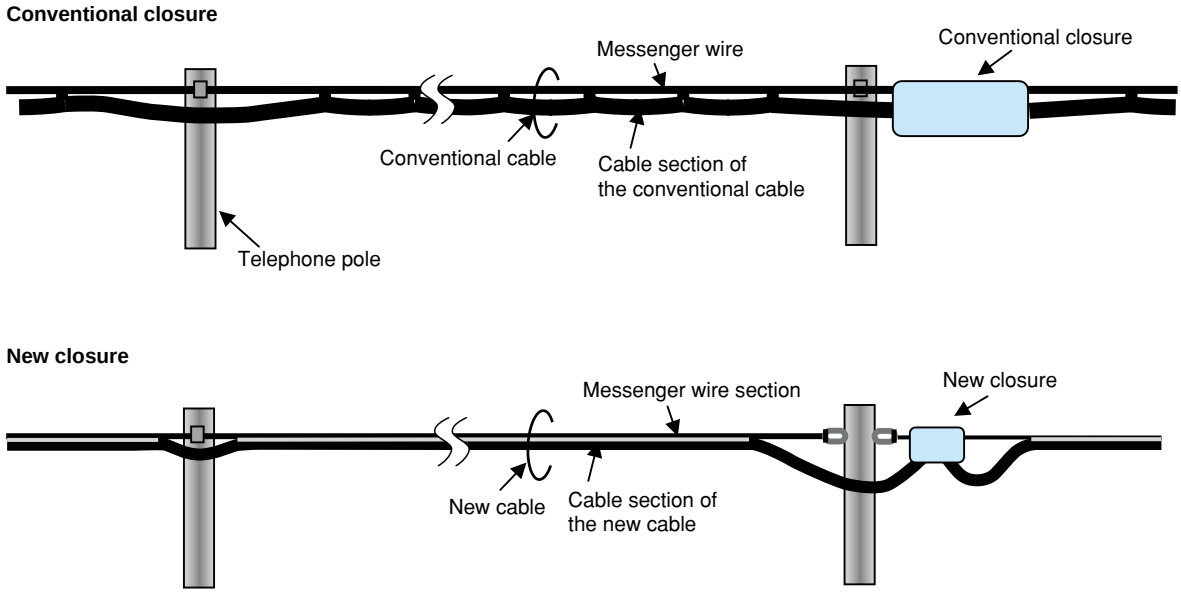
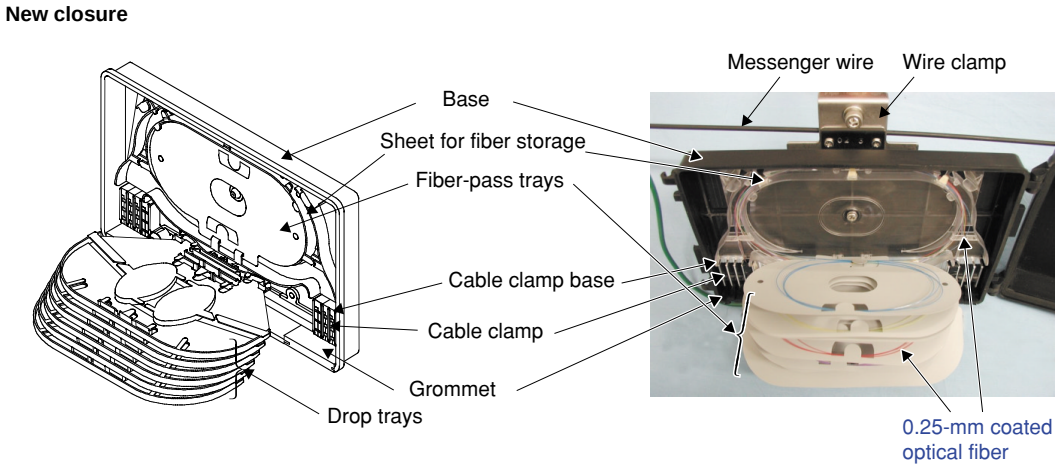


Fig. 3. Comparison of the closures.



Fiber-pass tray: accommodates an optical fiber passing through the closure to the terminal side.
Drop tray: accommodates an optical fiber dropped to a customer's house. (Right photograph: without drop trays.)
Sheet for fiber storage: stores eight optical fibers that go through the closure into a fiber-pass tray or drop tray.

Fig. 4. Structure of new aerial optical closure for connecting the new cables.

4. Improvements to existing closure

We also improved the existing closure to enable it to accommodate both the existing cable and the new cable. Closures of the improved conventional design will be applied to routes where the demand is estimated to be low enough to be handled by eight or fewer fibers. We developed metal fittings to clamp the new cable and a spiral tube to protect a single 0.25-mm-diameter fiber arranged in the closure.

References

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