Development of Thin Light-Colored MDU Indoor Drop Cable

Kenta TSUCHIYA*, Kazunari FUJIMOTO*, Masayoshi YAMANO, Hiroshi MIYANO, Yoshiaki NAGAO, Hiroki ISHIKAWA, Atsuhiro ONA, Taro FUJITA, Shinya NISHIKAWA and Hiroshi HAYAMI

This paper describes the newly developed 8-fibre bunched indoor cable that provides fast and easy installation for MDUs (Multiple Dwelling Units). The cable is composed of eight indoor cable elements which have thin and light-colored jacket. The cable is installed on the outside wall of an apartment house, and each optical element of the cable can be extracted at a subscriber's residence. The thin elements are beneficial for easy installation and the light-colored jacket can improve the external appearance of the apartment house.

Keywords: indoor cable, FTTH

1. Introduction

As of the end of March 2011, the number of FTTH service subscribers in Japan reached 20.93 millions, which is an increase of 3.13 millions compared to the end of March 2010. Of this number, subscribers in Multiple Dwelling Units (MDUs) account for around 40 percent. This indicates that FTTH service is installed in about 100,000 houses per month. Therefore, a simplification of the installation work is expected to save significant time and labor.

Under these circumstances, we developed an indoor drop cable for MDU installations. This cable eliminates the necessity of construction work for each house and improved construction efficiency in optical distribution to MDUs with small space.

In our current development, we have improved the handling characteristics of the indoor cable by adopting thinner optical elements. We have also developed a light-colored sheath to better match the external appearance of apartment houses.

2. Background of the Development

In conventional MDU wiring, thin and low friction indoor cables are commonly installed in individual houses by using the space of telephone conduits. However, as shown in **Table 1**, some small multiple dwelling houses do not have enough space in the telephone conduit or the telephone conduit itself. Therefore, it is difficult to wire additional optical cables.

In such a case, leading cable needs to be wired along the outer wall from the fiber distribution hub (FDH) of drop cable to each unit in response to each service order. Furthermore, the installation work requires the involvement of neighboring houses.

To solve these problems, we developed an indoor drop cable that consists of several optical elements bundled together. This cable is currently used for outdoor wiring to MDUs.

Table 1. Scale and wiring space of MDUs

Wiring space	Small scale (~ 10 houses)	Middle scale (10 ~ 50 houses)	Large scale (50 houses ~)
Telephone conduit	△~×	○	○
Meter box	△~×	△~×	×
	Fireproof treatment difficulty		
EPS	×	×	○
Elevator shaft	×	×	△

Figure 1 shows the basic structure of the MDU indoor drop cable. The cable consists of one polyethylene-covered support line and twisting eight optical elements all of which consist of a core optical fiber between two steel wires and are covered with flame-retardant polyethylene.

Figure 2 shows an example of MDU indoor drop cable wiring. When the house has no space in the telephone conduit, the MDU indoor drop cable is wired across several houses along the outer wall of the building and one of the optical elements is pulled out of the MDU indoor drop cable to be connected with the indoor cable in the house. Thus, by using the MDU indoor drop cable, optical interconnection is possible even if there is no space for FTTH wiring in the telephone conduit.

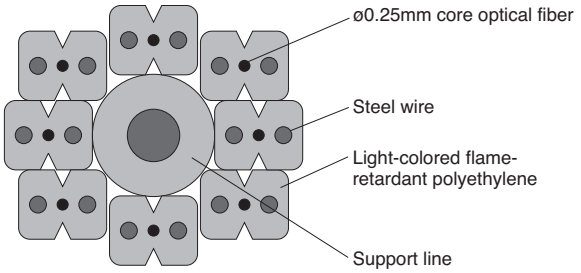

Fig. 1. Structure of MDU indoor drop cable

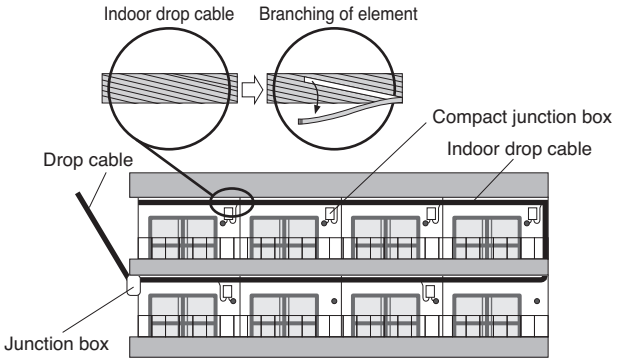

Fig. 2. Example of wiring in outer wall of MDUs

However, the sheath of the MDU indoor drop cable was conventionally black-colored for UV resistance. As it could interfere with the aesthetic design of the building when wired along the outer wall, expectation was growing for the development of a sheath that matches the outer wall of multiple dwelling houses.

3. Cable Structure

Table 2 shows main characteristics of the developed MDU cable. The basic structure of the cable is the same as that of the conventional indoor drop cable, which has optical elements twisted around the support line.

Using a thinner support line and optical elements, the new MDU cable has reduced the basic outer diameter by 16% and the basic mass by 11% compared to those of a conventional cable. Thus, the new MDU cable makes the installation easier. Furthermore, the connector used for the existing thin indoor cable can be reused for the new cable, as the size of the optical element is identical to that of the existing thin indoor cable.

Table 2. Specifications of indoor drop cable

Term		Specifications
Optical element	Fiber	Equivalent to G.657A1
	Tensile strength	Steel wire
	Sheath	Flame-retardant polyethylene (light gray colored)
Cable	Support line	Corrosion steel wire
	Sheath	Flame-retardant polyethylene (light gray colored)

4. Material of Sheath

Table 3 shows the main characteristics of the developed sheath material. Currently a black-colored sheath is used for UV resistance, which does not match the design of buildings. To address this issue, we have successfully developed a light-gray-colored sheath, while maintaining the UV resistance. This new sheath also has heat resistance and cold resistance. Thus, it confirmed that the sheath material is promising.

Table 3. Characteristics of the new sheath material

Evaluation	Test conditions	Results
UV resistance	Sunshine Weather-O-Meter 2000 hr Tension strength Tensile elongation	 80% or more 80% or more
Heat resistance	100˚C × 48 h Tension strength Tensile elongation	 80% or more 80% or more
Cold resistance	JIS C 3005	-30˚C or less

5. Cable Characteristics

5-1 Transmission and temperature characteristics

Table 4 shows the transmission and temperature characteristics of the new sheath. In each evaluation, the sheath shows good results.

Table 4. Evaluation results of transmission and temperature characteristics

Evaluation	Test conditions	Results
Transmission	Wavelength 1550 nm OTDR	0.25 dB/km or less
Temperature (-30 ~ + 70˚C × 3 cycles)	Wavelength 1550 nm OTDR	Loss fluctuation 0.15 dB/km or less

5-2 Machine and flame-retardant characteristics

Table 5 shows the evaluation results of machine characteristics of the preproduction optical element covered

Table 5. Evaluation results of machine characteristics of the optical element

Evaluation	Test conditions	Results
Side pull	IEC 60794-1-2-E3 1200N/25mm	<0.01dB No cracking
Impact resistance	IEC 60794-1-2-E4 4.9N,1m	<0.01dB No cracking
Flex	IEC 60794-1-2-E11 R=15mm	<0.01dB No cracking
Cable twist	IEC 60794-1-2-E18 ±90 degrees	<0.01dB No cracking
Tensile	IEC 60794-1-2-E1 Force 150N	<0.01dB No cracking
Flammability	JIS C 3005	Burn out naturally

wavelength 1550 nm

Table 6. Evaluation results of machine characteristics of the cable

Evaluation	Test conditions	Results
Side pull	IEC 60794-1-2-E3 1960N/100mm	<0.01dB No cracking
Impact resistance	IEC 60794-1-2-E4 4.9N,1m	<0.01dB No cracking
Flex	IEC 60794-1-2-E11 R=10D (D: cable outer diameter)	<0.01dB No cracking
Cable twist	IEC 60794-1-2-E18 ±90 degrees	<0.01dB No cracking
Tensile	IEC 60794-1-2-E1 Force 700N	<0.01dB No cracking
Flammability	JIS C 3005	Burn out naturally

wavelength 1550 nm

with the light-gray-colored sheath, and **Table 6** shows those of the preproduction MDU indoor drop cable. For both the optical element and the MDU cable, each evaluation result fulfills the requirement for the practical use.

6. Handling Characteristics of the Cable

Using the preproduction MDU indoor drop cable, a handling test was conducted in a simulated installation environment. The results are shown below:

(1) Unwinded from a drum

A 200-meter MDU indoor drop cable rolled up on a drum is easily unwinded and installed without falling apart.

(2) Wiring on outer wall

To wire the cable on the outer wall, the bundle of optical elements was fixed on the wall using screws. As the edges of the cable can be under high tension, the cable's support line was supported by fixtures. Each work was conducted easily.

(3) Connection in outdoor compact junction box

The core optical fiber is taken out from the optical element, and its end is connected easily to a drop cable.

(4) Branching of elements in the middle

Each element is identified by the number printed on the element surface. In this experiment, an optical element was selected at random and taken apart at the middle of the cable. The core optical fiber is easily removed from the element and connected to the indoor cable.

As explained above, the developed MDU indoor drop cable demonstrates good handling characteristics.

7. Conclusion

We have improved the handling characteristics of our MDU indoor drop cable by reducing its diameter and weight. We also developed a light-colored sheath material that matches the external appearance of apartment houses, while maintaining sufficient UV resistance. Thus, our thin, light-colored MDU indoor drop cable will help the FTTH service expand.

References

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Contributors (The lead author is indicated by an asterisk (*).)

K. TSUCHIYA*

• Optical Fiber & Cable Division
He is engaged in the development and design of domestic optical fiber cables.

K. FUJIMOTO*

• Optical Fiber & Cable Division
He is engaged in the development and design of domestic optical fiber cables.

M. YAMANO
• Assistant Manager, SEI Optifrontier Co., Ltd.

H. MIYANO
• Assistant Manager, Optical Fiber & Cable Division

Y. NAGAO
• Assistant General Manager, Optical Fiber & Cable Division

H. ISHIKAWA
• Assistant General Manager, Optical Fiber & Cable Division

A. ONA
• Group Manager, Optical Fiber & Cable Division

T. FUJITA
• Assistant General Manager, Electronics & Materials R&D Laboratories

S. NISHIKAWA
• Group Manager, Electronics & Materials R&D Laboratories

H. HAYAMI
• Senior Specialist
Department Manager, Electronics & Materials R&D Laboratories