■ Abstract

This report presents a systematic survey of stage lighting luminaires in Japan, organizing their development from the perspectives of application categories and optical systems. In addition to the general-lighting function of providing illumination, stage lighting luminaires are required to meet the unique demands of the performing arts: expressing the three-dimensionality of spaces, stage sets, and performers, and depicting changes in conditions such as time of day, season, and weather through lighting. Furthermore, because they must illuminate the large interior volume of a theatre, they have diversified into luminaires employing high-output light sources and offering a wide range of light-distribution characteristics. This study organizes these developmental processes in terms of light-source technology and optical-design.

First, the report explains the structures and characteristics of spotlights, footlights, and border lights from the incandescent-lamp era that were introduced into modern theatres, and examines the effects brought about by the tungsten-halogen-lamp luminaires that became widespread after the Second World War. It also describes the advancement of optical systems for profile spotlights and follow spotlights from the 1980s onward, and analyzes how the differing technical requirements for stage lighting luminaires across productions and theatre types influenced both the luminaires themselves and their methods of use in lighting for traditional performances, musicals, operas, and concerts. In particular, it illustrates how staging demands, such as controlling the shape of the beam edge, limiting the illuminated area, and achieving long-distance projection performance, were reflected in luminaire design.

Furthermore, the report highlights optical systems that use incandescent lamps, including halogen lamps, and incorporate proprietary technologies developed by domestic manufacturers, such as large-diameter plano-convex lenses and aspherical lenses, and clarifies the characteristics of Japan's unique technological development through comparisons with European and American equipment. These technologies were refined in response to the demands of the performing arts, providing the impetus for domestically produced stage lighting luminaires to establish their own distinctive optical designs.

Regarding the shift to LEDs from the 2000s onward, the report identifies both the challenges and advantages, including the spread of COB modules, improvements in color rendering, advances in thermal-management mechanisms, and the establishment of fundamental technologies such as dimming through PWM (pulse-width modulation) control. It shows how the emission characteristics, different from those of conventional filament and arc light sources, prompted a redesign of optical systems and led to a redefinition of the very structure of stage lighting luminaires. It also argues that LED adoption must be understood not only from the perspectives of light-source longevity and energy efficiency, but also as an optical and cultural turning point.

This paper presents the development of stage lighting luminaires from multiple perspectives, including light-source technology, optical design, and the practical application of the performing arts.