LED Lighting in the amateur theatre, as experienced at Medway Little Theatre
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Introduction

Myself

Professionally, I am electronics engineer who has specialised in audio, both military sonar and commercial speech enhancement and music systems. But I have been interested in amateur theatre lighting since my dear departed father taught me about coating 100w lamps with translucent lacquer to get colour effects. I was 10 or 11 at the time. As such I can sit easily in either seat in the control room. Not long after I reached 60, I started to take partial retirement and joined Medway Little Theatre as a full member, a few years later I was elected to my present position of Stage Director, having responsibility for all things technical within the theatre. Fairly early in my time at MLT I was asked what I knew about LED lighting. I can safely say that at that time it was all theoretical knowledge, other than a few second-hand LED lights and a simple DMX desk I owned for use at parties etc. As you will see that has change a bit now.

A history of Stage lighting development

For the earliest recorded stage lighting we look to the ancient Greeks who designed their theatres such that the afternoon sun shone on to the stage over the heads of the audience, the Romans improved on this by building canopies over the audience to increase the lighting difference, but still no real use of artificial lighting. Obviously, this was suitable only for outdoor performance areas. Moving theatre indoors C1500 brought candles into use, mostly in chandeliers, but also around the front of the stage, which is where the term footlights comes from, and on frames at the sides of the stage. By C1600 the use of reflectors had improved the efficiency of candle lighting. The constant smoke and dripping wax combined with continual wick trimming and relighting were troubling but tolerated. Towards the end of the eighteenth-century oil lamps, within metal enclosures, fitted with adjustable wicks and glass lenses were becoming available. Some theatre using coloured glass for special effects. Mineral oils such as paraffin, were much cleaner and more efficient than earlier vegetable or animal oils and also gave a much whiter light. The early nineteenth century saw the advent of installed gas lighting with dimming capabilities achieved by varying the flow rate of the gas. Later that century, the limelight appeared. Here the gas flame was used to heat a block of lime until it became incandescent and emitted a bright white light. By mounting this light source in front of a reflector a very contained beam could be obtained. The first-time electricity was used for stage lighting, again mid nineteenth century, was the carbon arc. Here an electric arc is maintained between two carbon rod electrodes, this being a very bright light source. In the earliest versions these lamps had to be started by bringing the two electrodes together to initiate the current flow, the slowly moving them apart until the arc developed. Later enhancements included a high voltage pulse trigger for starting purposes. These lights were extremely bright, the intensity could be varied a certain amount by a combination of supply voltage and arc gap. The biggest drawback was the need to be forever feeding the electrodes to maintain the correct gap. I actually had practical experience

of one such follow spot in the early 1970s at Liverpool University. Not long after the carbon arc, the incandescent filament lamp appeared, an invention credited to Thomas Edison. Initially using carbon filament but very quickly moving to metal ones.

By the interwar period virtually all stage lighting had changed from naked flame, to electric source, greatly reducing, but certainly not eliminating, fire risk. For the next three quarters of a century the majority of entertainment lighting was either incandescent filament, tungsten halogen being the final development, or arc, by now fixed metal electrodes in an inert atmosphere, with a noble gas filling, known as High Intensity Discharge. In the amateur theatre world this is still very much the case.

LED technology

As I already mentioned, I am electronics engineer and component technology has always been part of my job, so I have followed the development of the LED itself for many years.

The principle of light emission from the surface of a semiconductor junction has been understood for nearly a century, but it was not until the late 1960s that the first commercially available LED indicators became available. In the early days they were basically just fairly low intensity red indicators, used mainly to indicated the presence of a supply.

By the end of the last century, things had changed quite considerably, in that the use of blue light emitters with various phosphors allowed the production of other colours including white light LEDs. At the same time chip manufacturing had developed such that component density allowed practical, but extremely expensive and not particularly bright, multicoloured led arrays to be produced. These were fine for use as digital displays, but not nearly bright enough to be a practical luminaire. Most of the affordable devices of this period were the RGB “PAR Lights” (which is a misnomer, as there is no Parabolic Aluminium Reflector involved), used by mobile DJs and similar productions.

Over the first two decades of the new millennium, things moved quite rapidly in the right direction. So here we are now almost a quarter way through the twenty-first century, and there is an abundance of good quality, highly efficient, theatre spotlights, both Fresnel and profile, for under a thousand pounds each. In fact, there are plenty of Fresnel lanterns under £500 ea.

There are a lot of claims that LED lighting is 8 to 10 time more efficient than tungsten, this statement is based on comparing very high output, hence expensive, LED lamps with old fashioned domestic general service lamps. My experience, over the last couple of years, in stage the lighting scenario, is that the reality is about half that figure. Even so, at approaching 1/5 the power consumption for the same light output, it will not take long before LED lanterns have paid for themselves. Add on to that the benefit the ability to create almost any conceivable colour gives you, in some cases instantly using built in colour pickers provided as part of the software of modern DMX lighting desks, there is a considerable saving in time by not having to change Gels.

Looking across the present ranges of LED luminaires available, while there are beginning to be several manufacturers selling suitable units for amateur theatre, it is still obvious that the bulk of production is designed for large event stages. As such the pricing for wholesale adoption of LED is beyond the budget of many small amateur theatres. But the rapid development in this field, should change this state of affairs very soon.

Medway Little Theatre stage lighting

Following a bequest from Andrew Coulson, a long serving member of the technical team, which came with a request to use it to enhance the lighting capabilities, we have, over the last 12 months or so, embarked on a whole scale introduction of LED stage lighting, together with a lighting control desk to suit.

The 4 lanterns on the FOH bar above rows C and D are eLumin8 MP75 units, which are RGBW with a total power of 75 Watts. As a direct comparison with the well-loved Strand Patt123, fitted with a 650-watt tungsten lamp, these LEDs are somewhere between 75 and 80% as bright. When we found this to be the case, we had already purchased 12 at this time, we had to decide whether to return them as not suitable and look for something more powerful, or just buy more. The latter was the decision we took, based on comparative pricing and the flexibility and interchangeability of the extra MP75s.

These lanterns retail at approximately £250 each, but many suppliers will discount for nonprofit organisations.

The next hurdle was choosing profile spots to replace Patt23s (again with 650w tungsten lamps). I was fortunate to be at PLASA (the professional light and sound association exhibition) last year and had chance to look around the various options. In truth there are not many in the price range I was thinking. But one stood out quite brilliantly, pun intended, this was the brand new elumin8 Virtuoso 600. This is RGBAL that is red, green, blue, amber and lime green. This has a total LED power of 150 watts and is as bright if not somewhat brighter than the original Patt23 at well under 1/4 the power rating! There was a third, quite important part of the MLT stage lighting to be considered, we use a pair of fixed position 1kW Fresnel lanterns as general full stage washes. At first, I had no idea of a cost-effective unit to replace these. At PLASA this year I decided the elumin8 Virtuoso 2000, a 220-watt RGBAL device, would be a suitable candidate for the job. The quoted beam width and luminosity are not quite as good on paper as their incandescent counterparts, but when you take into account the controllability as well as power saving, it became obvious that was the way to go.

So far, I have been concentrating on stage lighting, but this auditorium is also totally LED lit, except for a couple of low power incandescent lamps amongst the dimmable LED units, which seem to reduce the flicker of the LEDs and we are gradually replacing all incandescent and fluorescent units, as they fail, with LED equivalents.

Demos

MP75

Virtuoso 600

Virtuoso 2000

3.6 UV

Benefits and drawbacks

Benefits

Lower power and long life of the light source

LED lanterns consume approximately 1/8 to 1/5 of the power of incandescent lamps and according to various scientifically recognised prediction methods, should have lives in excess of 25,000 hours. Taking an approximation of 6 shows a year each of 14 performances, including rehearsals (with technical support) and 4 hours use per performance, gives us 336 hours a year usage. That would predict a life of 75 years. There are probably several other factors that will reduce that figure, but it is an interesting starting point.

Multi-colour

Whilst there are specific white, either fixed or variable CT, the most common LED luminaires are at least RGB, many RGBW, some RGBAL. It is also possible to get ones with added UV functionality. I would avoid this unless you specifically need it, as you can get more visible light for the same power consumption without it, and have a couple of UV floods when needed.

Rapid change where required. By this, I mean should different scenes require different colouration there is no need to physically change anything it is all controlled at the desk.

4.2.3 Control of lantern, not socket

You are always controlling a particular fixture, or group thereof, and once again any changes are desk soft patching or grouping not physical cable patching.

Drawbacks

Initial cost

Unless you are building a new theatre you probably have quite a good collection of legacy lanterns, many of which still have life in them, but tungsten filament lamps are definitely on the way out. All Western European and American manufacturers have long ceased, and most have stopped importing, so running cost of tungsten lamps is increasing.

Learning curve

Here we come to use of modern technology in general, I am fortunate to have had a career where, if not leading edge, certainly very recent technology was predominant. So, though I am over 70, digital control is no mystery to me. That is not true for many of my contemporaries, and particularly those more senior. Here we must look to our youth members and get them involved in lighting.

Power and DMX distribution

Every fixture now has at least two connections, power and DMX, four if Daisy chaining is provided. This does suggest a more permanent standard base rig, with provision for specials as required.

Keeping track of which lantern has what address

This is a point to consider, if you are not going for a fixed rig.

Early LED units had physical DIP switches to set DMX address, these provided some way, if you could decode binary numbers, of reading the address when no power was applied.

Modern software setting requires the display to be on to read. We have actually stuck printed labels on every lantern.

Chromatic aberration and colour fringing

CA, the difference in defraction angle of different wavelengths of light across a lens, has always existed, but the use of physically discrete different coloured LED sources exacerbated colour fringing in early lanterns, in modern high density COB sources this is reduced.

Conclusions

I am pleasantly surprised at how well affordable LED stage lighting now performs. Having spent a whole decade, since I first became a full member of MLT, following developments in theatre lighting, I have found the benefits of LEDs now outweigh their drawbacks. Although I know future advances will mean even better value for money, I truly believe we have made the right decision to move to LED technology now.

Prices

MP75. £250

Virtuoso £600-£780

Virtuoso £2000

Mike Aldington, October 2024