

A wagon with a set on it raised to allow the drive cassette in the elevator beneath to engage with the toothed belt on the side of a wagon which has run past on the lowered elevator in the foreground.



Photos: Techplan, courtesy Royal Opera House

changed without the normal off-centre kick that you get with a single castor. The compensating elevators in the Royal Opera House are hydraulic and they are simply a system of levers with rollers which lift the top platform by lever arms. The guides for the elevators are passive scissors mounted underneath, one in each direction at right

*Solutions to one of the most difficult technical problems in major opera houses are described as applied in the Gran Teatre del Liceu in Barcelona, in the Royal Opera House, in Gothenburg Opera and one of the compact systems used in Japan.*

To carry out a move of a simply drop the compensating form the route in front of the in the wagon in the gap, or is been formed.

secrets of the system is the are described in the video as ades; it's actually ultra-high molecular polyethylene, which is a type of plastic which has got a very, very low coefficient of friction against itself. We formed an edge to all the wagons, all the compensating elevators and all the stage elevators out of this plastic. It is actually quite a nice way of finishing off wagons, because the timber fits inside it so you don't see any timber edges; it's black, and

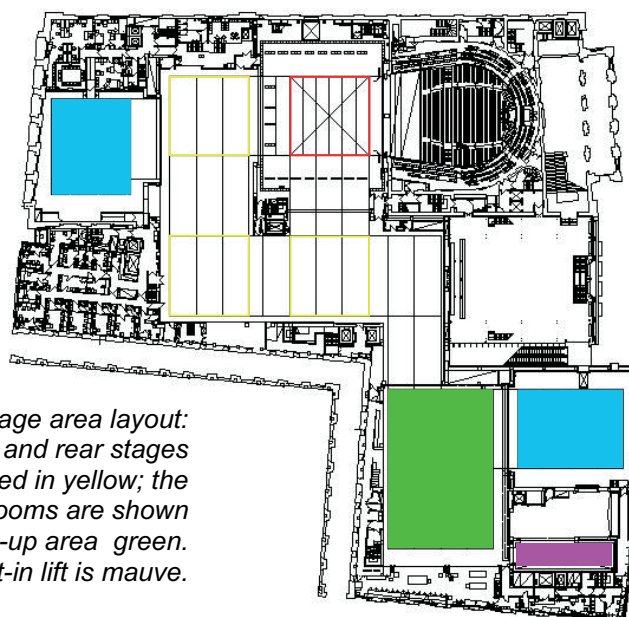
we work to a very small tolerance gap, which was a minimum of 1 mm and a maximum of 5 mm at every join;  $\pm 2\frac{1}{2}$  mm (0.1"), something like that. And in fact we found during the prototype tests that the tighter we could keep the gaps the better the guidance worked and the better the wagons ran.

The layout of the stage in the Opera House shows the six elevators in the main stage and around it; on stage right, there is a side stage and upstage a rear stage. Off to the bottom of the picture there is a space which is what we call the fit-up area. This is adjacent to one of the rehearsal rooms. Scenery being delivered or collected is brought to the fit-up area by the get-in lift. When the scenery is constructed, it can be moved into this rehearsal room or moved around the corner and into the side stage and rear stages, ready for movement onto stage.

There was a problem with the planning of the Opera House because of the shape of the site – Bow Street runs down the front of the building, and the Piazza cuts in backstage – and we have a pinch point where we could only fit two wagons. So scenery, if it's built in the fit-up area, has to be able to break down to fit on two wagons only. Some sets have to be brought round onto the main stage area before final assembly. But once on the main stage area, you can run a group of three wagons around, and obviously they can go both up and down and across stage.

We divided the stage area as efficiently as possible. We had just enough room to get the width of three wagons side by side, so we actually have a sort of parking position between the side stage and the main stage and between the rear stage and the rear side stage. And the space at the back is particularly useful for storage of scenery in the rep. This is often quite full, and the space between the stage and the side stage is also useful because sometimes you need to push a set out of the way to get something past it, for which this space is particularly helpful.

At the rear of the stage there is another rehearsal room. This was built some 20 years before the main redevelopment and has been kept. Its floor is at stage level, so when we take wagons in there they have to be lifted up to stage level and roll in on top of this floor. Fill-in rostra elements are then placed around the wagons to get a level



The stage area layout: the main side and rear stages are outlined in yellow; the rehearsal rooms are shown blue and the fit-up area green. The get-in lift is mauve.