AES 59th Conference on Sound Reinforcement Engineering

An electro-acoustic conundrum – Improving the listening experience at the Park Avenue Armory

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Die Soldaten - Opera

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Art Exhibitions

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Interactive Exhibitions

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Merce Cunningham - Dance

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Lincoln Center - Symphony

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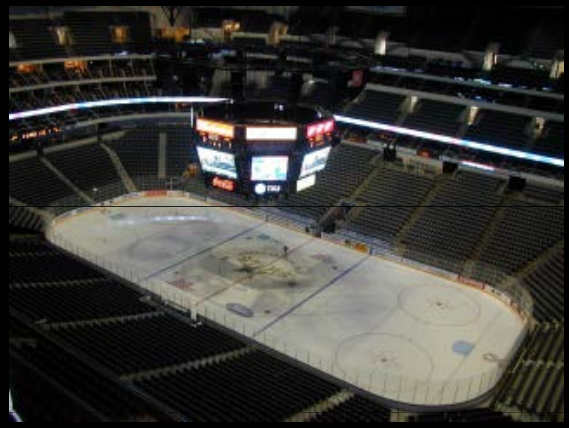
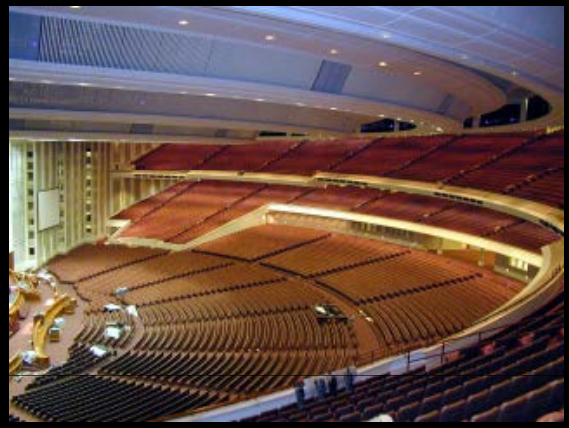
Park Avenue Armory

- There are two important factors that influence the design of electro-acoustic systems used to alter the perceived acoustical conditions in a space:
  - The physics of the venue
    - Size, surface treatments, geometry
  - Programming
    - Who will do what (where, how, etc.)

Examples of Large Installations





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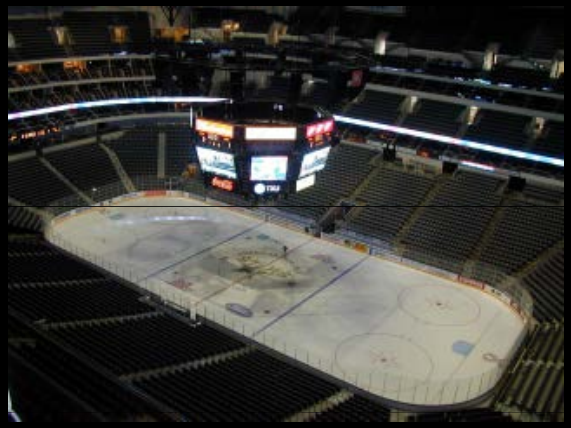
Examples of Large Installations

- In each of the examples we can readily identify the nature of the sound source(s).
- We know something about the location of the sound source(s).
- We know something about the expectations for acoustical delivery.
- We can design infrastructure to support a variety of programs without the need to make substantial physical changes to the system.

Examples of Large Installations



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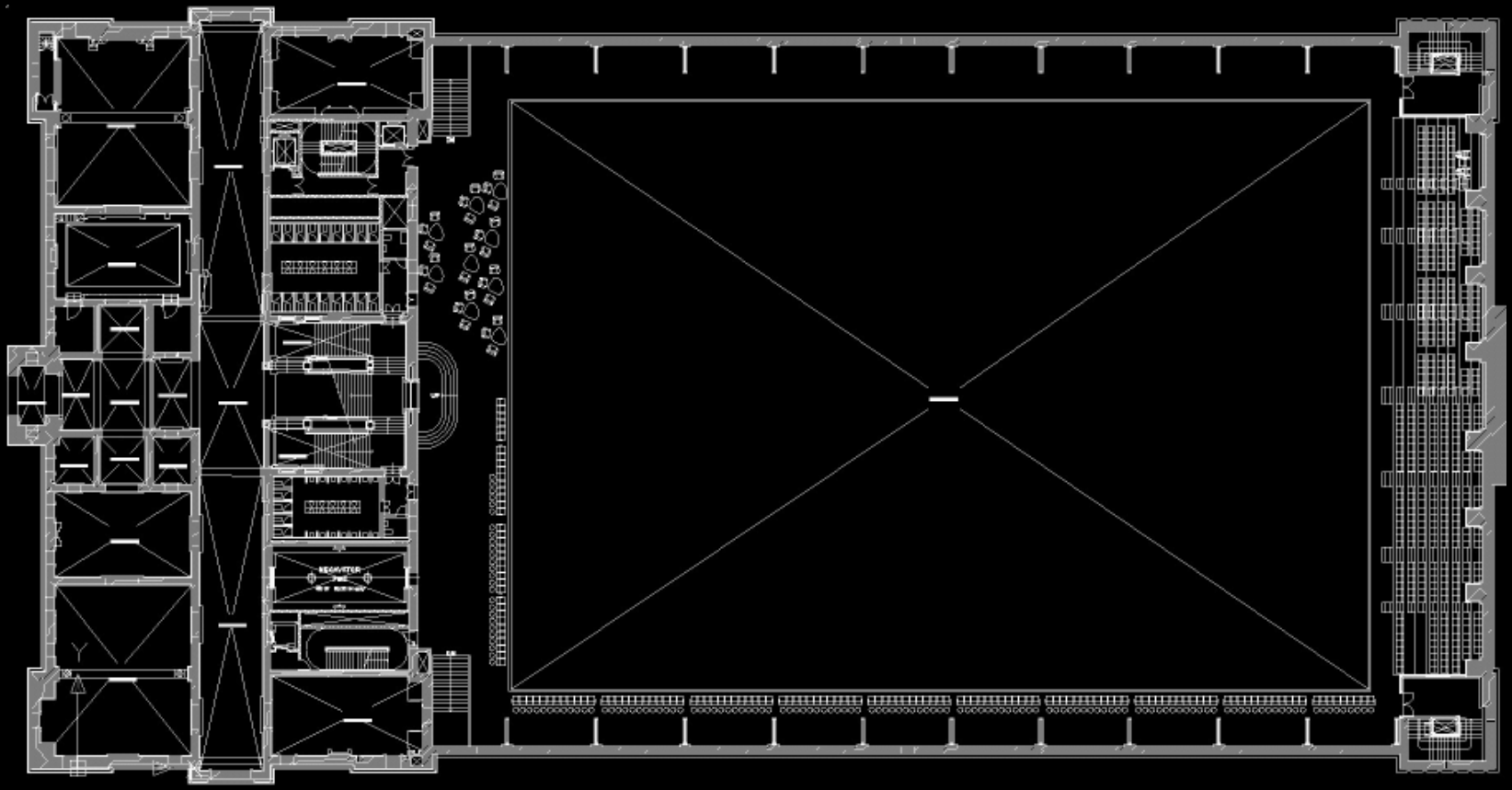
Park Avenue Armory



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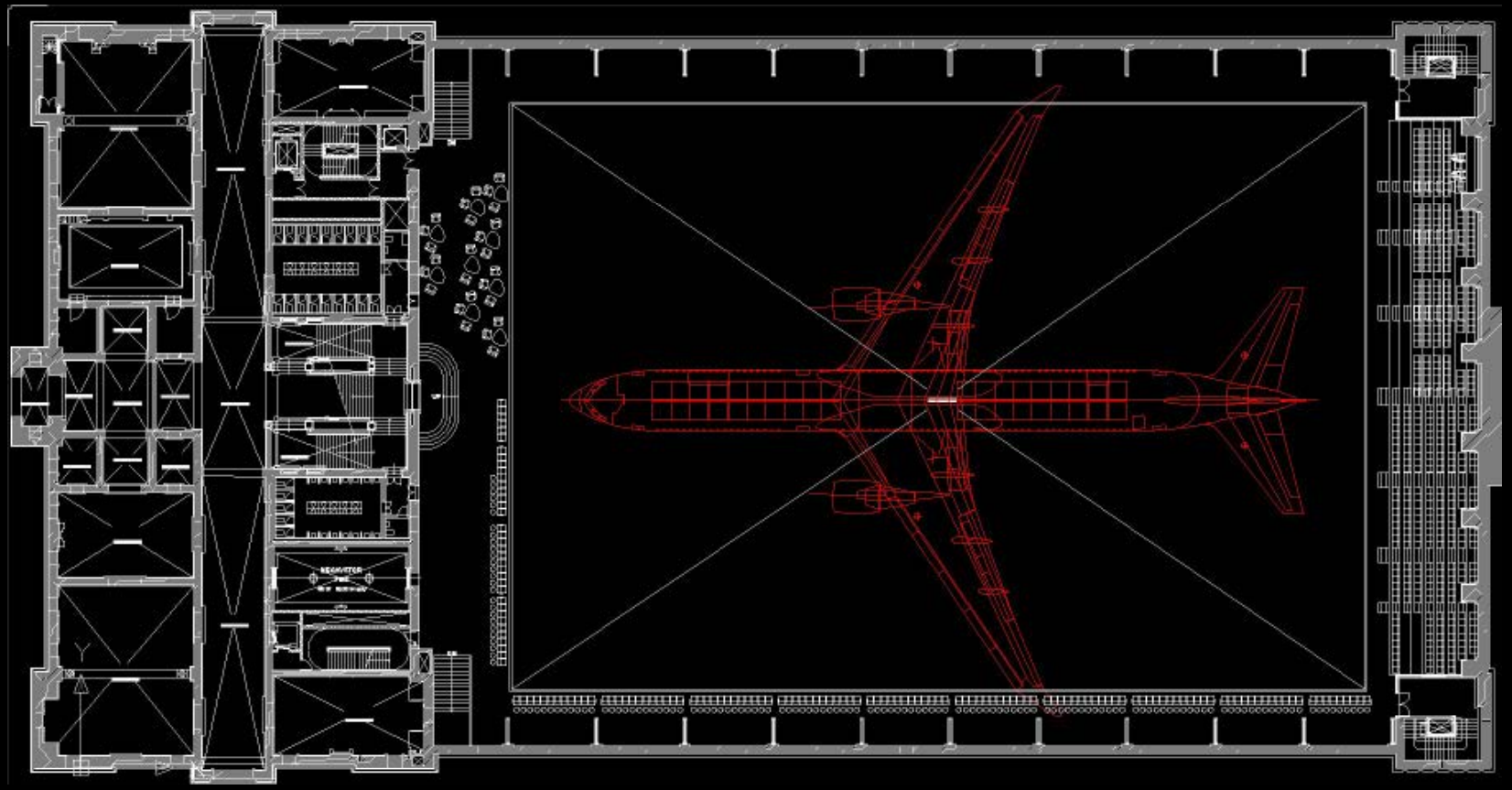
Park Avenue Armory



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Typical System Installation

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Park Avenue Armory

- All of the infrastructure in the Armory is moveable and configured to meet the demands of a given performance.
- Much more complex than a touring event.
  - Involves multiple trades and crews that must be coordinated.
- The equipment may need to move to different locations in the space – or be divided and placed in multiple locations.
- The Armory decided that amplifiers and cable for each production would be rented.
- Thus, the system design and integration is far from "typical"

Important design considerations:

- Large matrix mixing capacity to accommodate “anything audio”.
  - Multiple zones of sound reinforcement
  - Multiple independent inputs for surround sound, 2D, and 3D sound, and live tracking.
  - Multiple acoustic processing engines with independent or summed I/O.

System Overview:

- 512 channel point-to-point matrix with 320 hardware I/O.
  - 64 Digital Input channels for Sound Reinforcement (AES-EBU or MADI).
  - 16 Analog Input channels for Sound Reinforcement.
  - 16 Microphone Inputs for Acoustic Enhancement.
  - Up to 64 Input channels from Independent Acoustics engines.

Basic Signal Flow: E-Architecture, E-Performance

Microphone signals converted to MADI and Sent to Matrix Processor

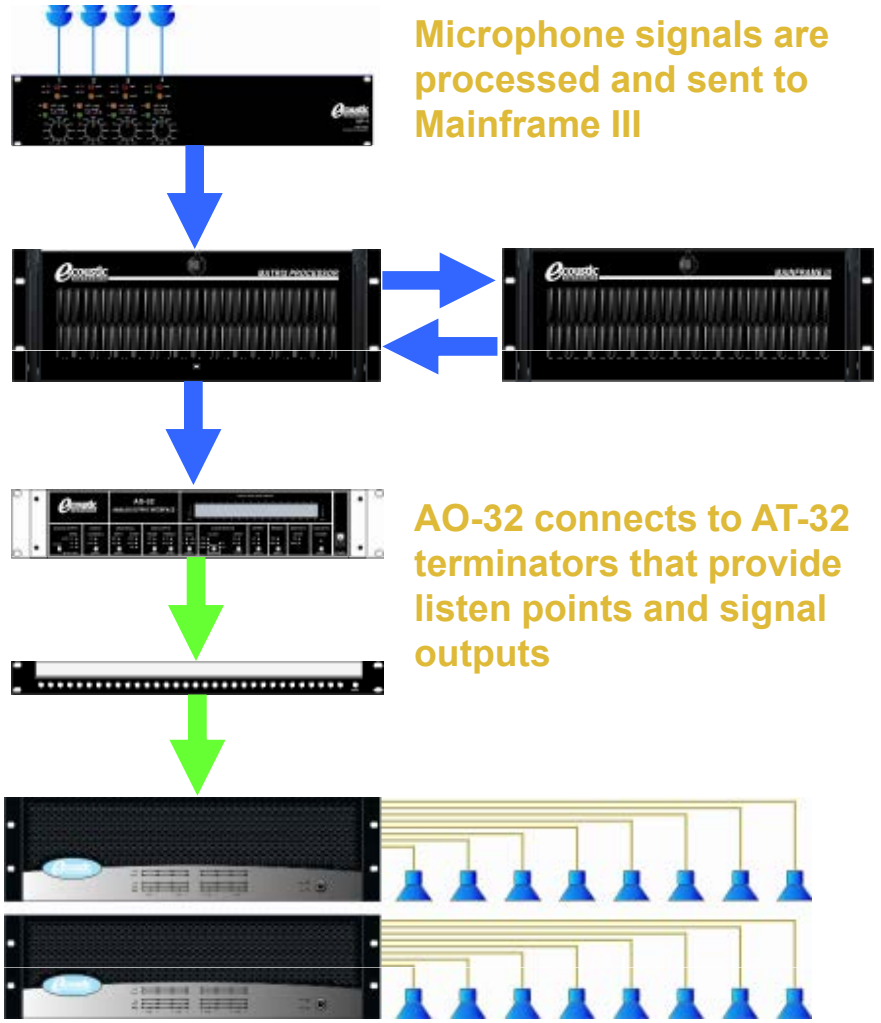
Microphone signals are processed and sent to Mainframe III

Signals from virtual Acoustics Machines are assigned to Matrix Processor MADI Outputs

MADI signals are sent to AO-16 or AO-32 for Analog Conversion

AO-32 connects to AT-32 terminators that provide listen points and signal outputs

AT-32's connect to amplifier outputs that feed loudspeakers.



System Layout “Machine”

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Important Loudspeaker Considerations:

- Sufficient number of loudspeakers to meet design objectives for electronic architecture.
  - Typical two-way with HF pattern control will not work.
  - Must have broadband power uniformity.
  - Must generate sufficient power.
- Sufficient number of loudspeakers to meet design objectives for Direct/Early reflected energy.
  - Broadband pattern control extremely important.
  - SIZE of the loudspeaker enclosure is important.

Large Format Direct Loudspeakers

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Comparison to typical 2-way

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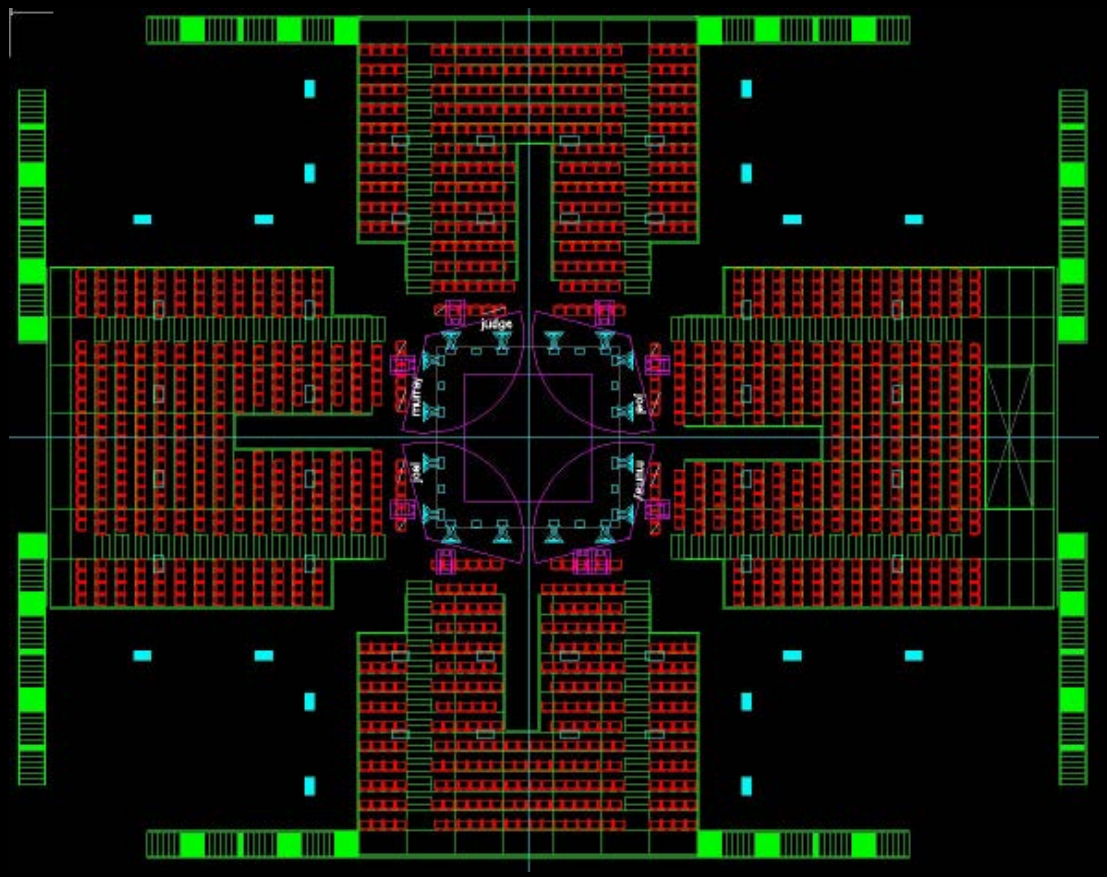
Enhancement Loudspeakers

Machine – Plan View



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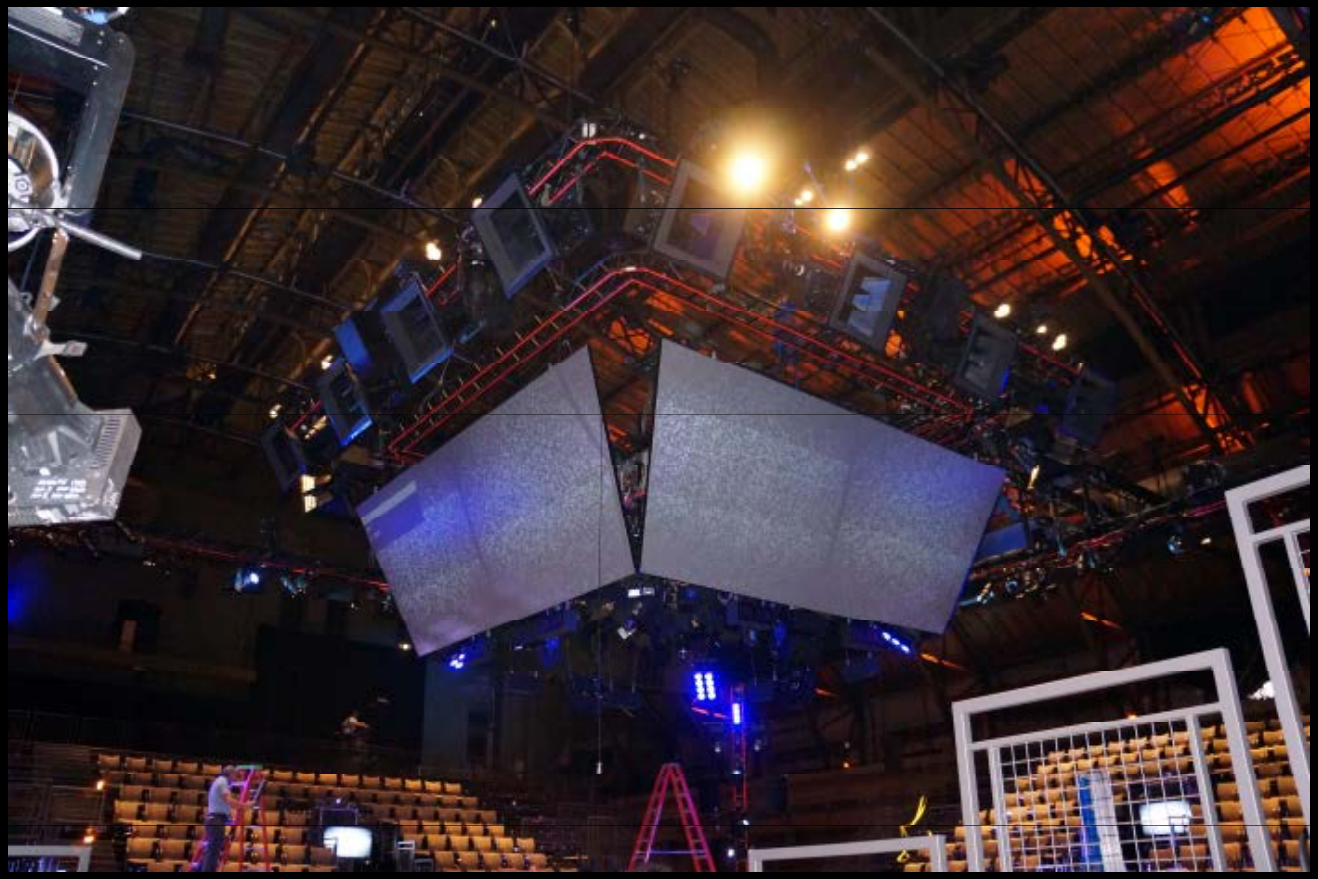
Machine Primary SR



Machine Overhead SR

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Line Array Microphones

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Machine

Passenger

Passenger

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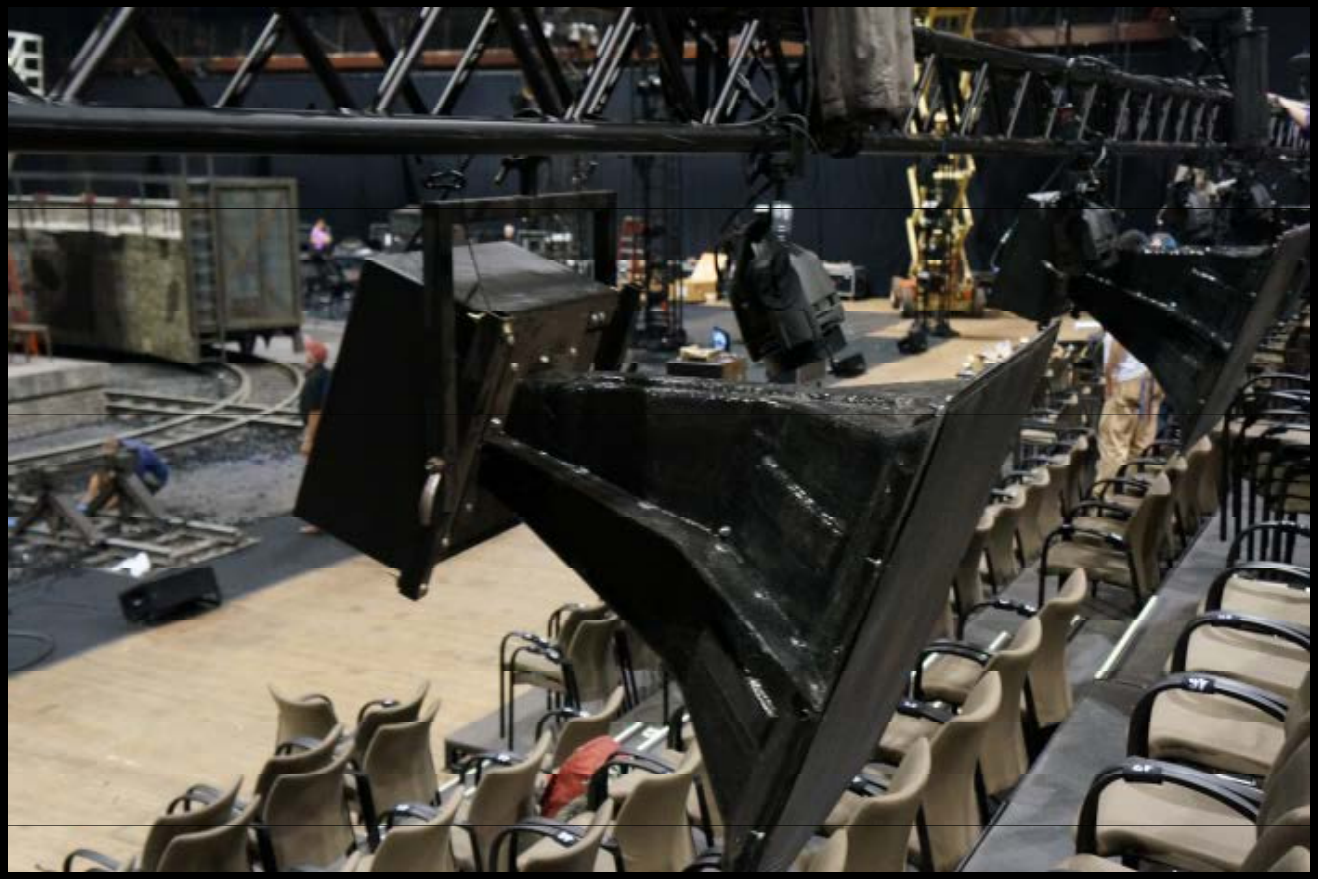
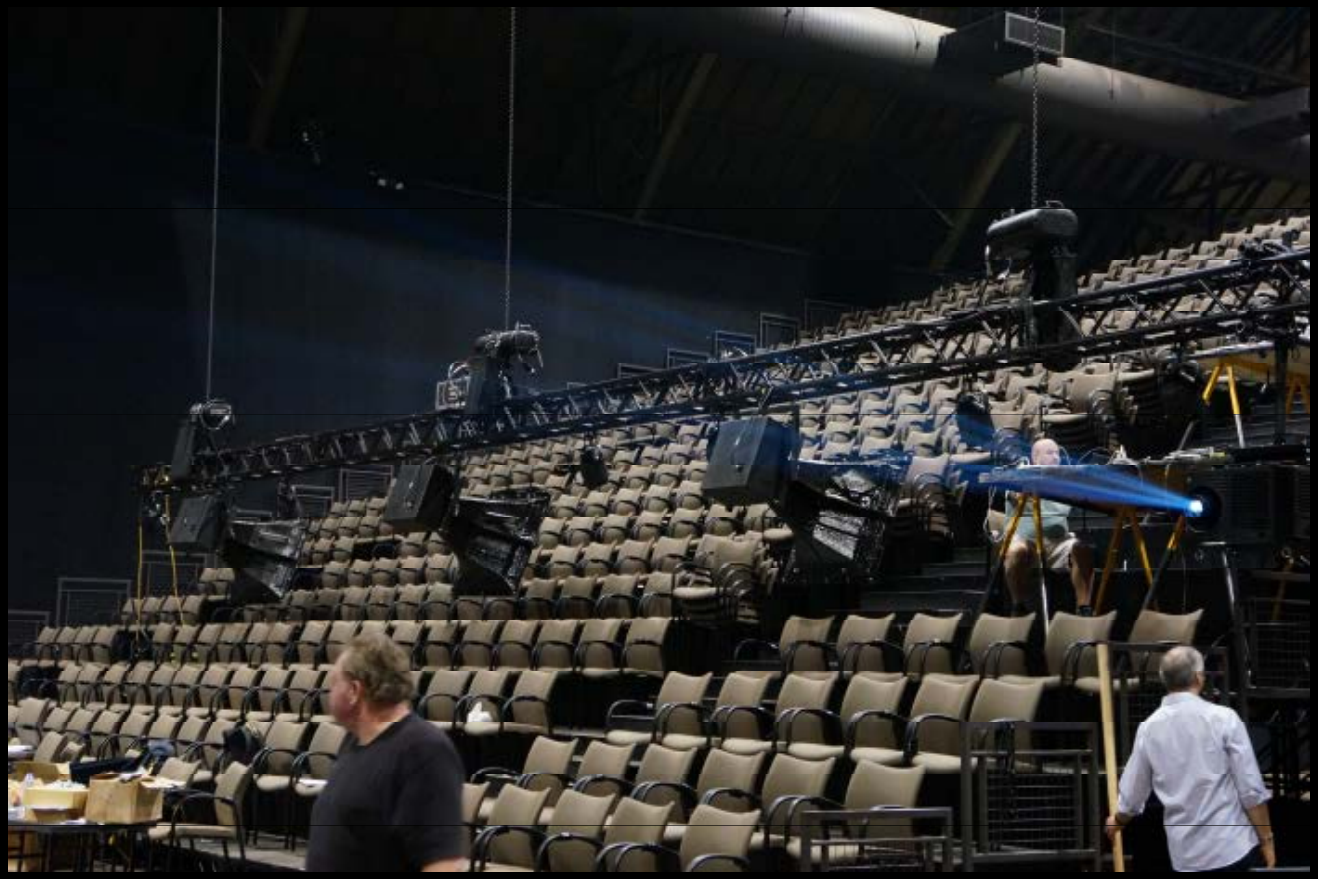
Passenger Reinforcement

Passenger Delayed SR

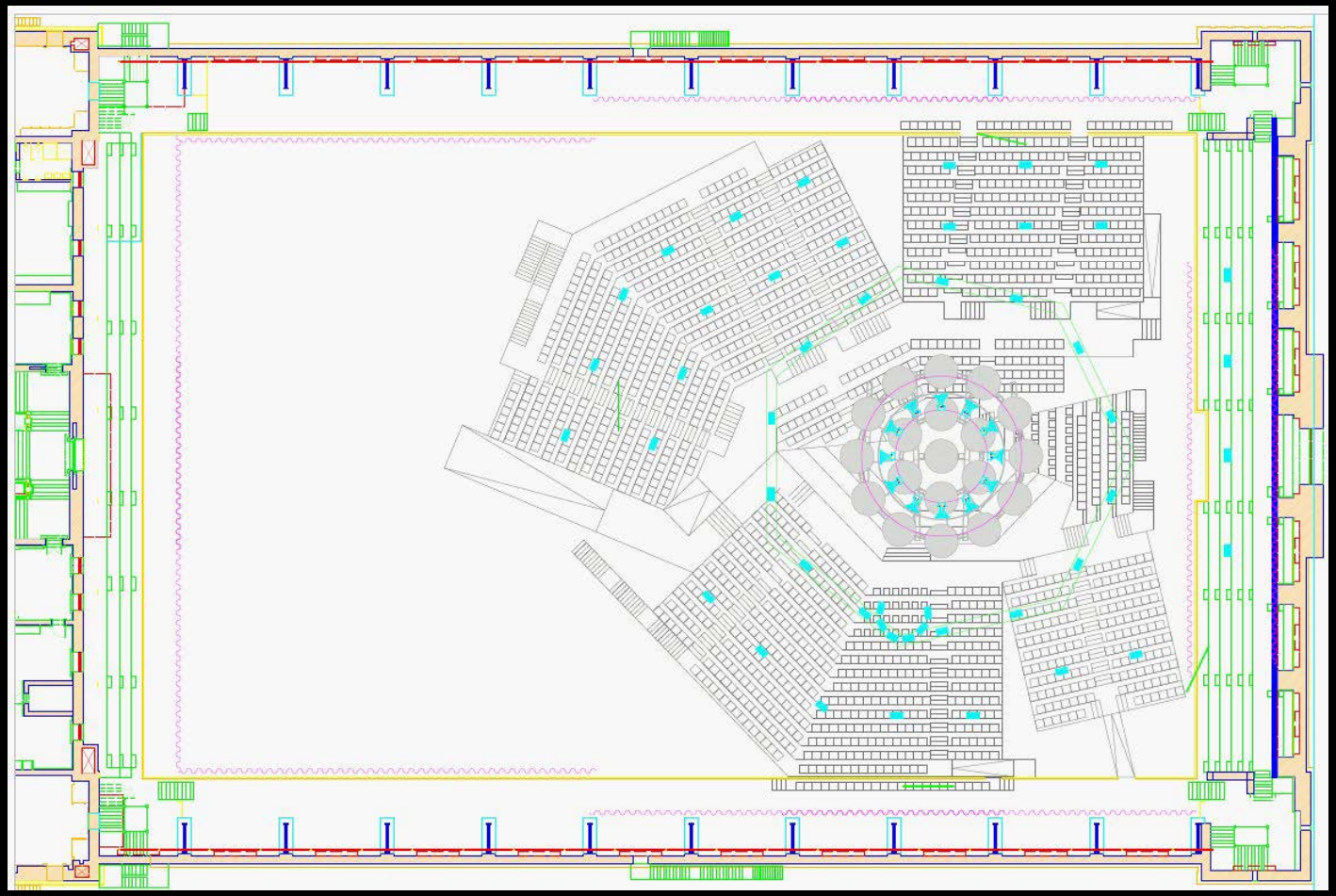


Passenger Delayed SR



Passenger

St Matthew's Passion



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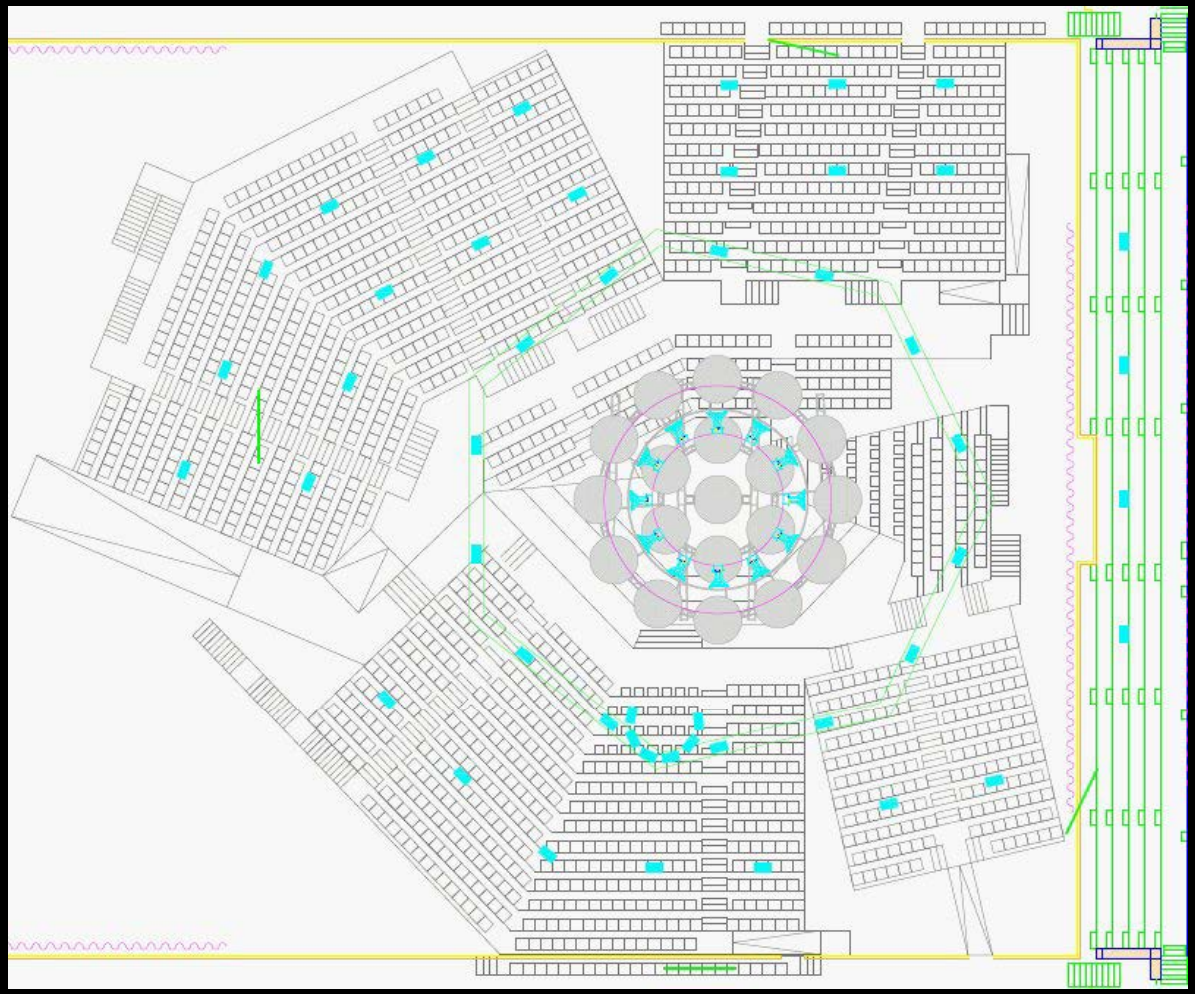
St Matthew's Passion



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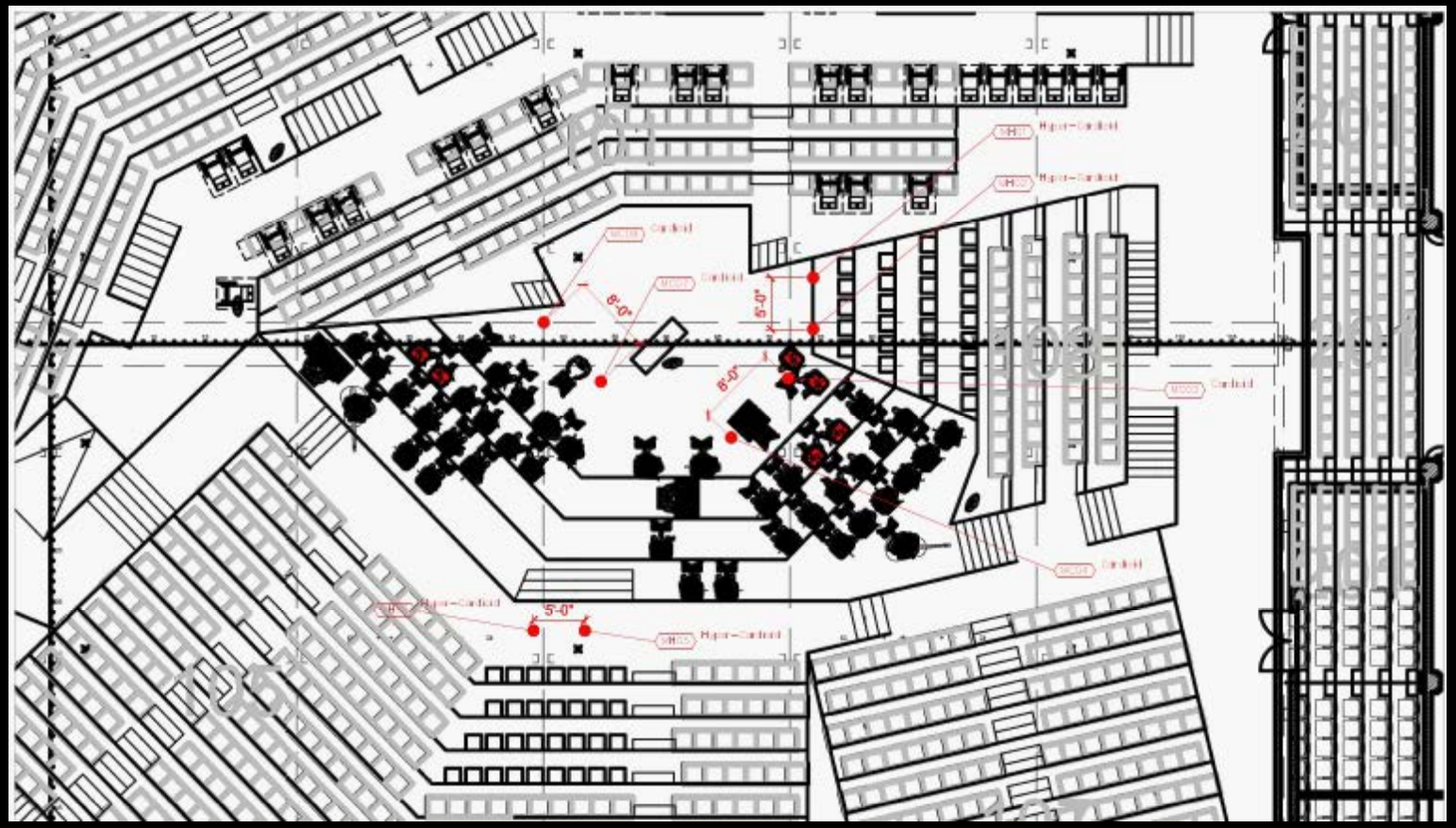

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St Matthew's Passion

St Matthew's Passion

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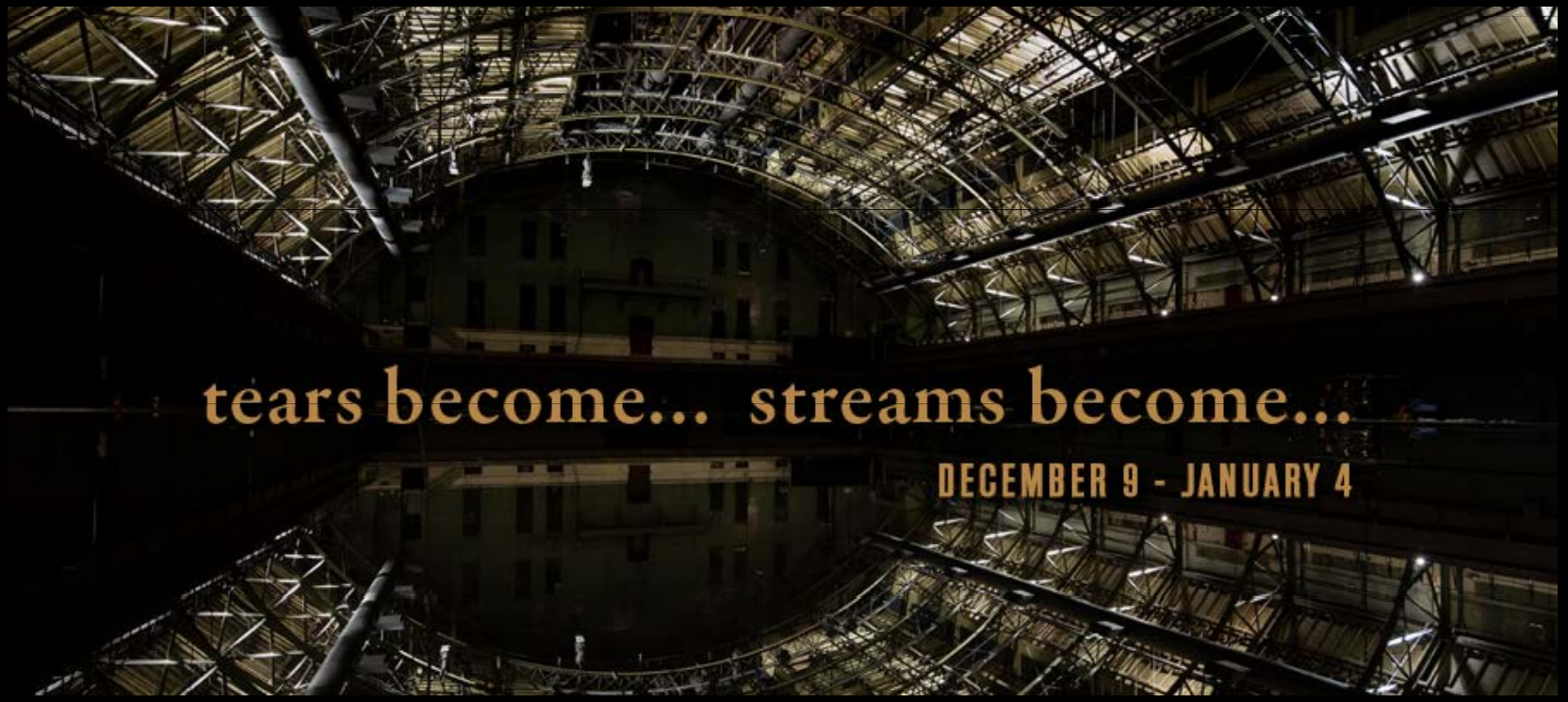
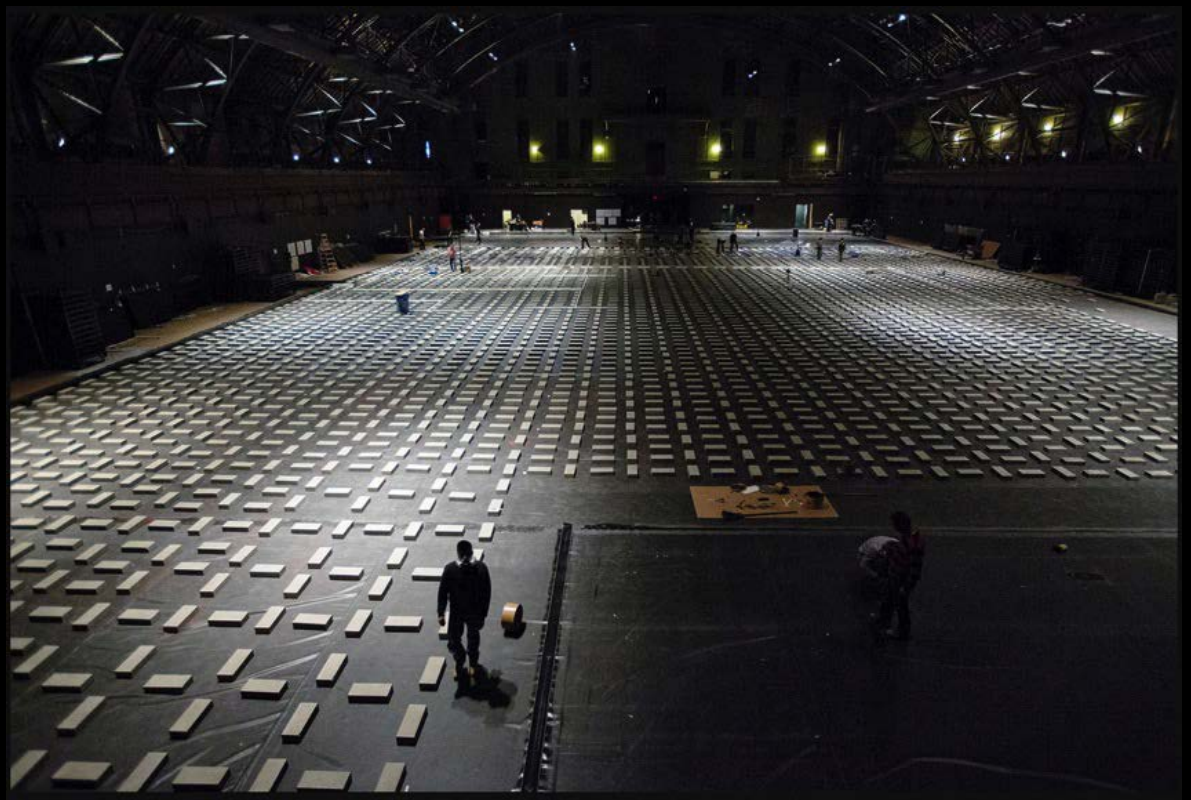
Helene Gramaud



Massive Engineering Undertaking

- The artists “vision” was to build a pool of water on the entire floor of the Armory that would create a mirror image of the space above.
- Arup Engineering were hired to develop the means to make it work…
  - Structural engineering for weight loads
  - Waterproof floor construction
  - Materials that would not be affected by – or affect – water
  - Creating a completely level surface on a floor of this size
  - Silent water pumps and plumbing
  - Temporary water storage and filtration
  - Humidity levels that would not affect the Steinway Pianos

False Floor – Pool



The French pianist Hélène Grimaud will perform a one-hour program of works inspired by water as a controlled flood transforms the hall's 55,000 square feet into a giant, glassy lake. Workers laid 7,000 concrete blocks on the floor to create a level base for the pool.

Ruth Fremson/The New York Times

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Helene Gramaud

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Conclusions

- We have demonstrated to both the Armory as well as Lincoln Center that this approach can produce very successful results.
- We have also demonstrated that LARES can be successfully integrated with body mic techniques and produce a reasonable semblance of a “natural” environment.
- You cannot ignore the natural acoustics of the space, and must plan to provide temporary absorption to reduce RT or control problematic late reflections.

Conclusions

- Each “performance” is a unique design that requires careful integration of acoustical treatments as well as electro-acoustic audio components.
- The nature of the building makes any production labor intensive.
- When enhancement is required, the need for uniform loudspeaker density has proven to be cost prohibitive for some productions.
- The unique nature of the Drill Hall allows for very unique programming. Such programs are typically labor intensive in any venue.

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Questions & Discussion