Arch 464
ECS
Spring 2014 **Name**_____

Quiz #4

"Do Light and Music Mix?"

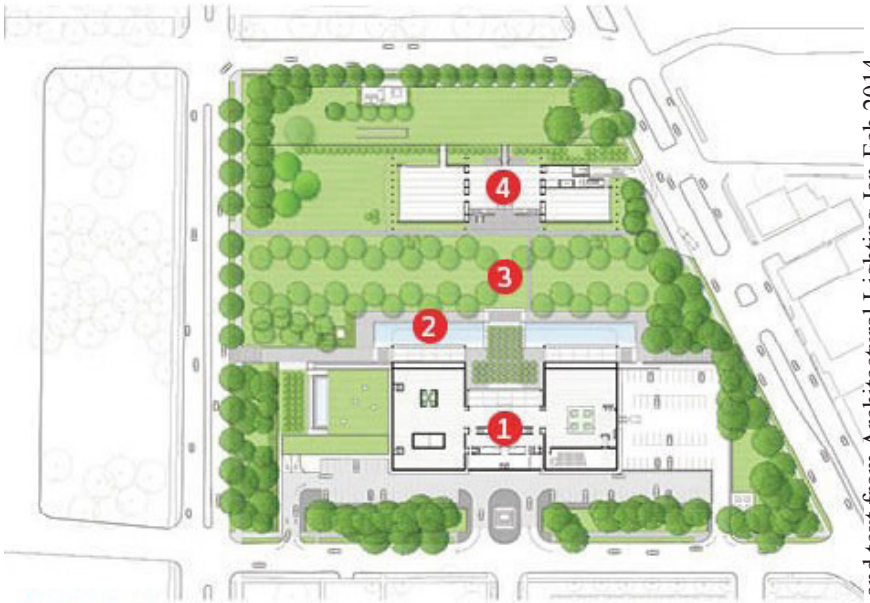
Read and look at everything before you write!

For this problem you are an acoustics critic reviewing the auditorium of the new Renzo Piano addition to the Kimbell Museum originally designed by Louis Kahn.

"Some buildings are known for their architectural form, some for their use of materials, others for their quality of light. In the case of the Kimbell Art Museum in Fort Worth, Texas, designed between 1966–72 by architect Louis Kahn, it's the perfect triumvirate. How then, could anyone think of disturbing this masterwork, which has secured its place as an icon of modern architecture?" Your question is, "Does the acoustic environment of the auditorium match the standards set by the luminous environment of Kahn's building and those of the Piano Pavilion?"

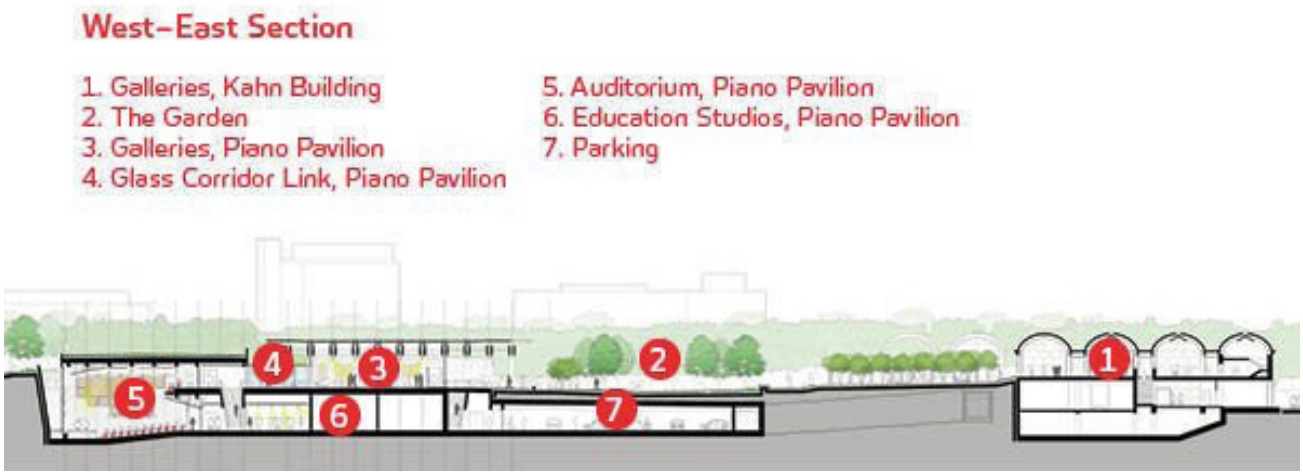
Above. Piano's pavilion is in the foreground with Kahn's building in the bakground to the far left. The auditorium is covered by the green roof to the right.

Site Plan



1. Kahn Building
2. Reflecting Pool
3. The Garden
4. Piano Pavilion

Illustrations and text from Architectural Lighting Jan-Feb 2014.



"Piano's design for the new building is respectful of Kahn's work, drawing inspiration not only from its architectural organization and attention to materials and textures, but its masterful use of natural light, which infuses the interiors with a sublime quality. And just as Kahn worked with lighting designer Richard Kelly to develop a lighting strategy for the project, so Piano worked with the lighting group at Arup on the illumination design of the new addition. It is not the first time RPBW has worked with the lighting team at Arup. The two firms have collaborated on a number of art museum additions over the past decade, including the High Museum in Atlanta, the Art Institute of Chicago, and the Isabella Stewart Gardner Museum in Boston.

"At the Kimbell, the new building, referred to as the Piano Pavilion, houses gallery spaces, a 298-seat auditorium, classrooms, the education department offices, an expanded library, art preparatory areas and storage, a café, and a gift shop. It faces east and sits exactly 65 yards wall-to-wall from Kahn's building.

"To tackle the lighting in the new Piano Pavilion, the Arup team knew they would have to make a careful study of Kahn and Kelly's work, not just in terms of the technical components but the qualitative as well. "We did a thorough assessment of the Kahn building looking at what made the lumen levels, what the distribution of the light was, and what was the luminance distribution on the surfaces of the gallery spaces," says Arfon Davies, associate director of lighting in Arup's London office who led the lighting efforts alongside associate lighting designer Giulio Antonutto. "It quickly became apparent that the feeling of light there is much more significant than the actual amount of daylight in the space. It's a very clever trick; when you enter the gallery space you feel the presence of daylight is much more significant than it actually is. That was something that we really felt was an important characteristic of the Kahn [building] that we wanted to try [to use] and form the design of what we would do in the Piano Pavilion."

"Another area where light plays a significant role is in the auditorium. Natural light permeates the space through a light well that sits behind the stage and its rear glass curtainwall. The cant of the light well was calculated to bring in the greatest amount of natural light. At the base of the curtainwall, a line of shielded wallwashers keeps the source out of view from the audience and the performers. Theatrical lighting is suspended from the ceiling along with Piano's Le Perroquet fixtures, which are each fitted with a 28W 3000K LED module."

—Elizabeth Donoff

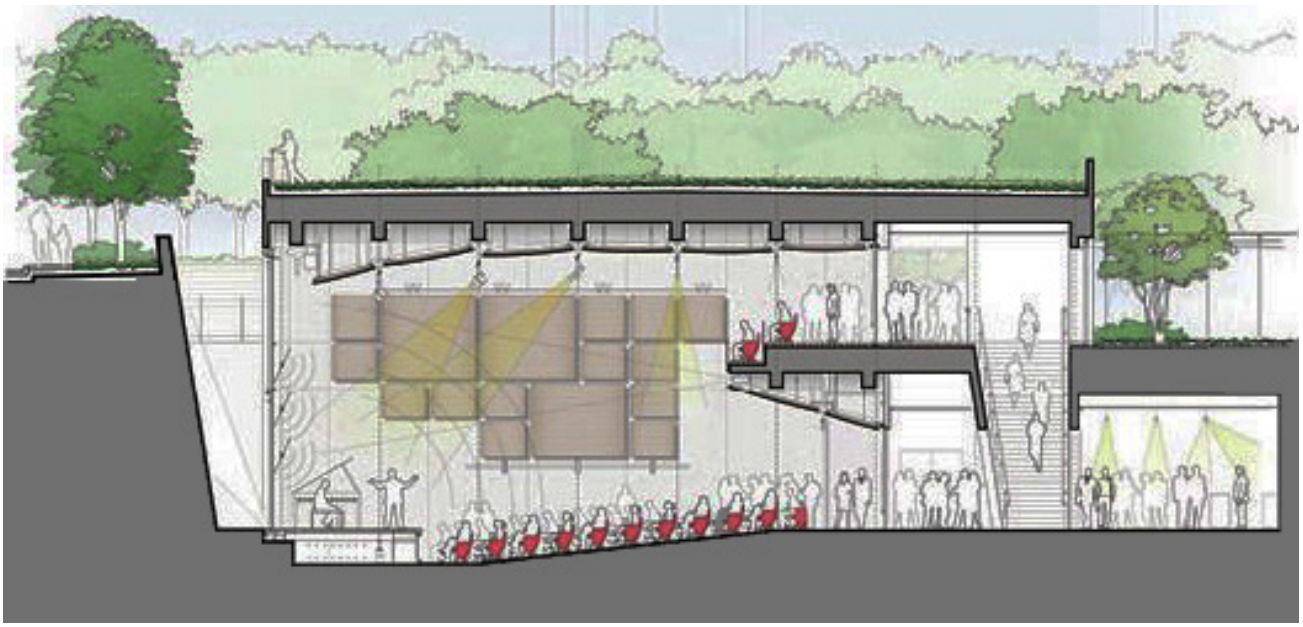
Analysis

1. The schematic plan diagram shows the 10' x 10' grid of the auditorium. How would you classify this hall and what types of performances would it best support? Explain.

2 points

2. Do spectators get early reflections from the ceiling? Carefully construct ray traces from the piano off the reflective ceiling panels to the audience? Explain why or why not the scheme is effective.

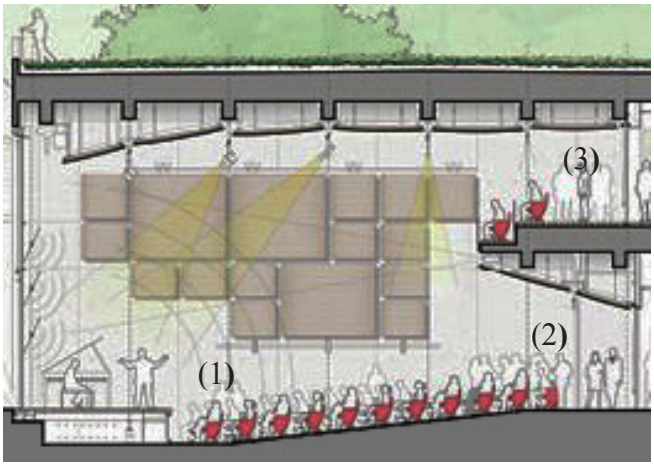
2 points



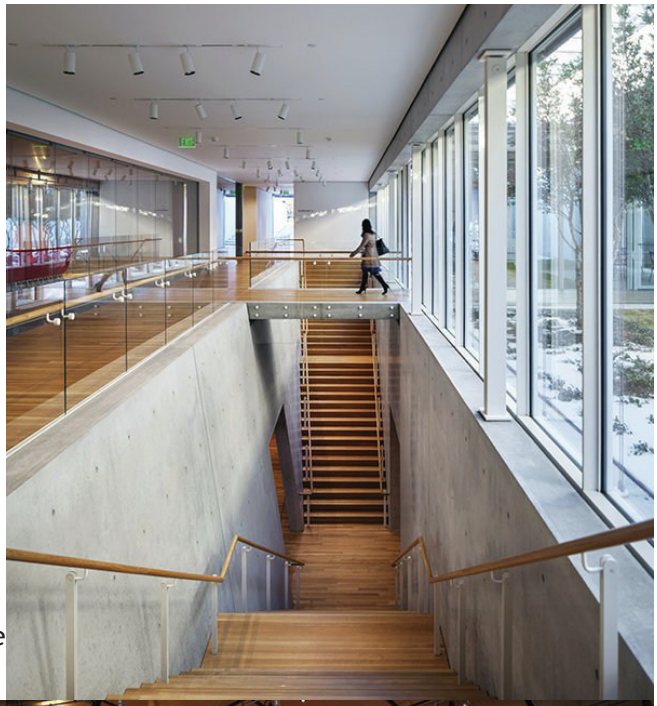
Critique

3. Describe the acoustic merits of seating in three areas of the auditorium (1) front row seat next to the center aisle, (2) back row next to the side wall, and (3) wheelchair seating behind the second row of the balcony.

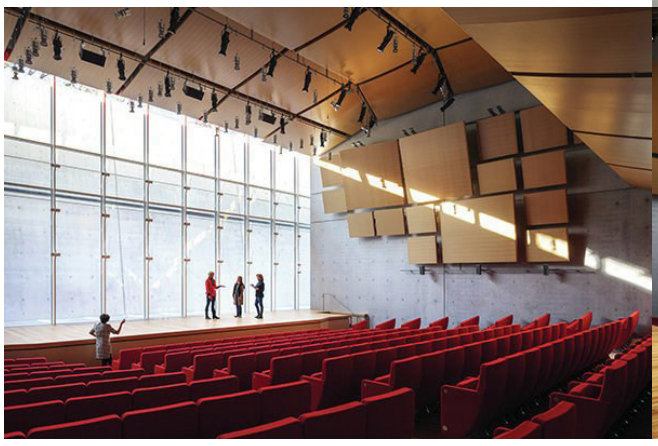
3 points

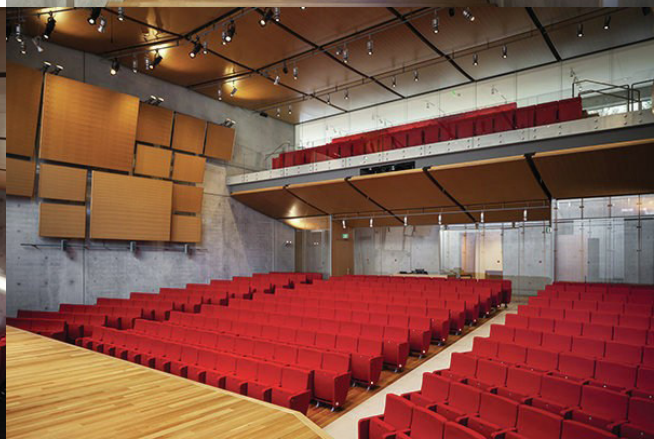


Positions 1, 2, and 3 in section.



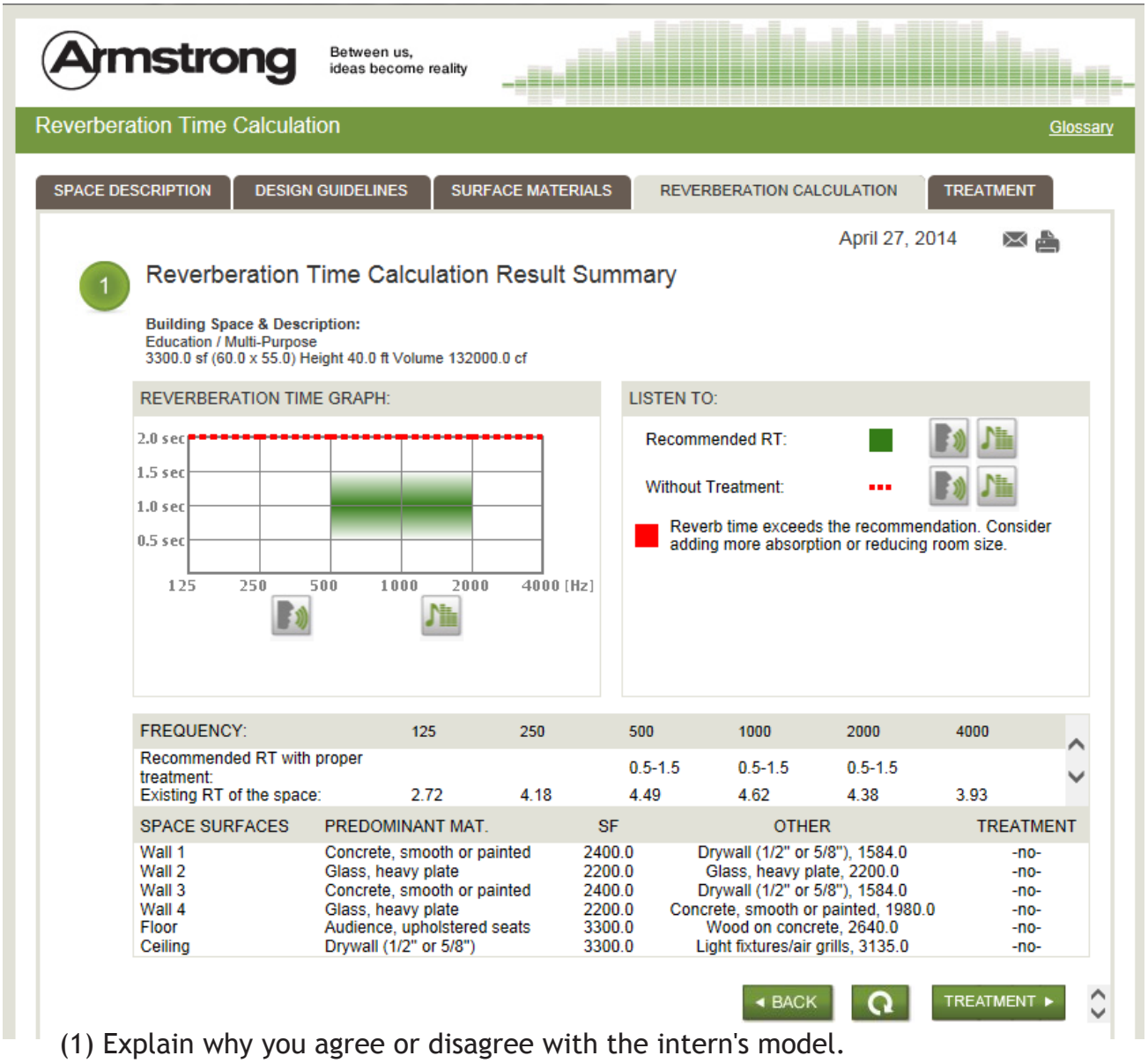
(top) A bridge over the stairways to the main seating area leads to the balcony seating.
(left) The wall behind the stage is of heavy plate glass that allows daylight to enter the auditorium.
(right) The side walls are exposed concrete with reflective panels, the back wall is plate glass, and the upholstered seats are red.





4. Noting the predominance of hard surfaces in the auditorium, it seems that the reverberation time maybe a bit long. Your intern modeled the 55' x 60' x 30' room in the Armstrong reverberation time calculator and obtained the results below. The acoustically reflective panels were modeled as drywall.

3 points



Armstrong — Between us, ideas become reality

Reverberation Time Calculation — Glossary

SPACE DESCRIPTION | DESIGN GUIDELINES | SURFACE MATERIALS | REVERBERATION CALCULATION | TREATMENT

April 27, 2014

1 Reverberation Time Calculation Result Summary

Building Space & Description:
Education / Multi-Purpose
3300.0 sf (60.0 x 55.0) Height 40.0 ft Volume 132000.0 cf

REVERBERATION TIME GRAPH:

LISTEN TO:

Recommended RT:

Without Treatment:

Reverb time exceeds the recommendation. Consider adding more absorption or reducing room size.

FREQUENCY:	125	250	500	1000	2000	4000
Recommended RT with proper treatment:			0.5-1.5	0.5-1.5	0.5-1.5	
Existing RT of the space:	2.72	4.18	4.49	4.62	4.38	3.93

SPACE SURFACES	PREDOMINANT MAT.	SF	OTHER	TREATMENT
Wall 1	Concrete, smooth or painted	2400.0	Drywall (1/2" or 5/8"), 1584.0	-no-
Wall 2	Glass, heavy plate	2200.0	Glass, heavy plate, 2200.0	-no-
Wall 3	Concrete, smooth or painted	2400.0	Drywall (1/2" or 5/8"), 1584.0	-no-
Wall 4	Glass, heavy plate	2200.0	Concrete, smooth or painted, 1980.0	-no-
Floor	Audience, upholstered seats	3300.0	Wood on concrete, 2640.0	-no-
Ceiling	Drywall (1/2" or 5/8")	3300.0	Light fixtures/air grills, 3135.0	-no-

◄ BACK | TREATMENT ►

(1) Explain why you agree or disagree with the intern's model.

Continued, next page

(2) Interpret the results of the model and explain how voice and music would sound in the auditorium.

(3) Recommend material changes to make the auditorium more suitable for a variety of uses.

Extra Credit: Describe a strategy for presenting digital slide shows in the auditorium and how the strategy would effect the room acoustics.

2 points