Tate Modern

ECS LAB#3_A SUSTAINABLE SITE & BUILDING

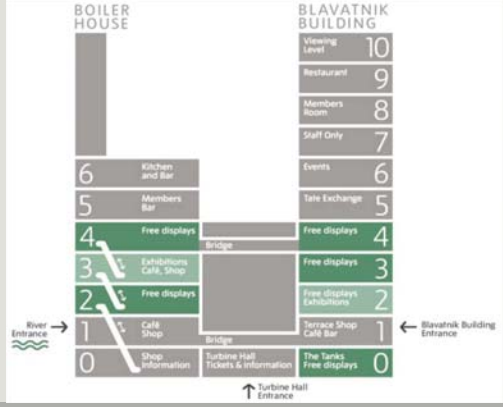
SHUDAN HE, HAONAN XU, JINJIE LI

Building Description

Tate Modern is a modern art gallery located in London and it is based in the former Bankside Power Station, in the Bankside area of the London Borough of Southwark.

On summer 2016, the world's most popular gallery for modern art completed an ambitious expansion project, adding 60% more space for visitors. Costing £260 million, the distinctive **10-storey structure**, designed by architects Herzog & de Meuron, is an incredible gift to London's public, and signifies the completion of London's transformation from an industrial powerhouse to a cultural one.

This building made by two parts, that's 7 levels part and 11 levels part. Its height responding to the iconic chimney of Giles Gilbert Scott's power station. It has a total internal floor area of 371,350 sq ft. The façade using brick to match the surface of the existing structure, while creating something radically new – a perforated brick lattice through which the interior lights could glow in the evening. Windows and the terrace appear as cuts in the brick surface.



Performance Analysis QuestionA:SUSTAINABLE FEATURES-Air

Servicing vehicle traffic is anticipated to result in a minor adverse impact on local air quality at nearby road junctions, reducing to negligible with distance from these junctions and along Southwark Street. (the Development provides for **only 20 car parking spaces**)

The absence of any heating plant systems for the completed Development means that this aspect will inherently have a negligible impact on local air quality.

The thermal mass is cooled at night. **Outside air enters the spaces through high-level automated, opening windows** on one side of the building, and exits on the opposite side.

As per the international loan standards for art, the temperature is maintained between 18° C and 25° C, and the relative **humidity (RH) between 40% and 65%.**

SUSTAINABLE FEATURES-Water

The drainage and floor management strategy was designed to minimies both the risk of flooding and the impact to the existing downstream sewer system.

"Firstly the building's geometrical design means that the external walls intersect the ground at seven different angles. With a normal building, this angle would be 90 and the water can run down the wall and into the channel below. However, with the Tate extension, a **standard Brickslot drainage channel system could not be used**." Oversaw the bespoke design process for the extension's proposed solution. "In total seven sections needed to be developed, which translated to **17 bespoke products**. To accommodate this, our team designed a hanger system to allow structural concrete to be filled and levelled between the channel and the wall in such a way that when the Brickslot tops were added, the system was fully supported and **allowed the drainage section to follow the contours** of the building. "

A drainage and flood management strategy was designed to **minimise both the risk of flooding and the impact to the existing downstream sewer system.** In order to minimise the impact to the existing downstream drainage network, the proposed surface water discharge rate has been reduced by **80%** from that of the existing surface water runoff rates, including and up to **1 in 100 year** storm events. To minimise the risk of flooding and to comply with Planning Policy Statement 25 (National Planning Policy Framework), an additional **20%** allowance in the rainfall intensities due to climate change, was incorporated into the design.

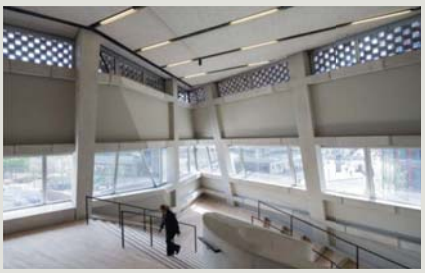
SUSTAINABLE FEATURES-Light

The scheme for public circulation comprises **bare fluorescent lamps** slotting between **precast concrete panels**. **LED cast-glass** decorative pendants add character and sparkle to the dining spaces without distracting from the spectacular views over London.

Galleries on Level 3 are more intimate spaces with **track and spotlights only.** The larger galleries on Levels 2 and 4 are supplied with **homogenous ambient light** using **high color rendering fluorescent lighting**, with exposed lamps on Level 2 and backlit ceilings on Level 4. Half of the Level 4 gallery space also has generous – but controlled – levels of **daylight** through a system of **skylights** above the ceiling, with the sunlight blocked by external shading and the **daylight diffused** to create a comfortable and appropriate daylit environment for viewing and for protecting the art on display.

The **LED spotlights** used in the galleries – barely distinguishable in quality and appearance from traditional halogen lighting – more than halved the gallery energy demand from that of traditional galleries.

The use of Pilkington Sun cool glass will mitigate against the potential occurrences of glare, so that the residual impact of the instances of glare are considered to be of negligible significance.



SUSTAINABLE FEATURES-Energy

Energy: It uses **ground water pumped** from river gravel below the site, desiccant dehumidification and even **waste heat** from electrical transformers to create the ideal environmental conditions for the Tate's priceless works of art, while ensuring millions of visitors are comfortable.

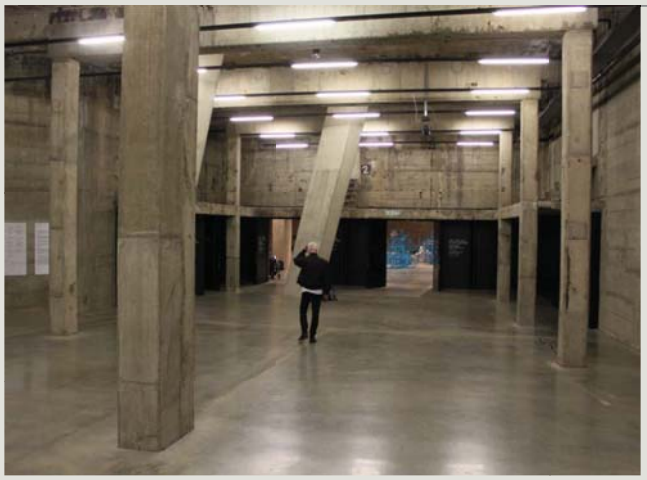
A **displacement ventilation system** supplies conditioned air to the extension's three gallery floors; conditioned air is supplied through floor grilles and extracted at high level.

Each gallery has a dedicated air handling unit (AHU). In an unusual **low-energy solution**, the engineer has pioneered the use of ground water trapped in a five-metre-deep bed of river gravel beneath the site as a source of cooling for the AHUs.

The Switch House opened its doors to visitors in June. It is early days for the environmental systems but, over the course of a year, Max Fordham's scheme is expected to use **50%** less energy than a typical gallery.

By exploiting heat emitted from EDFE's relocated transformers, adopting ground source heating and cooling as a renewable form of energy and employing passive design principles wherever practicable, the scheme will achieve **44%** saving in carbon emissions and **54%** energy reduction over the baseline scheme. A key factor would be the activation of the structure and use of the facade to **bring in natural light whilst minimising solar gain**. The development would also **incorporate natural ventilation** in non-gallery spaces.

SUSTAINABLE FEATURES-Reuse & Reduce



A design review of the project to transform the Tate Modern site in London identified easy to implement ideas to reduce construction waste with the potential to reduce total project costs by **£142,017**, reduce the amount of waste produced on site by **3524** tonnes and avoid **430** lorry movements from the site.

The ideas generated at the workshop were evaluated by the design team in terms of their waste reduction potential and their feasibility for implementation on the project. Two of these ideas were selected as being the most appropriate for quantitative analysis: **recycling demolition material for landscaping** instead of disposing of it and importing material to the site; and **reducing drylining of internal walls** by increasing fair-faced/rendered finishes.

SUSTAINABLE FEATURES-Ecology

Tate Modern Community Garden

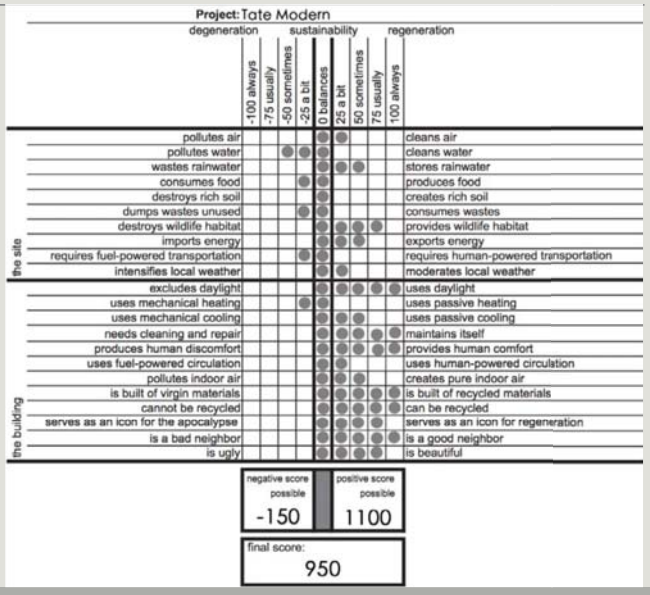
A desk-based data review, Phase 1 Habitat Survey
and bat surveys were undertaken to determine the
ecological value of the site. The review of baseline
conditions and the ecological evaluation has revealed
that the following ecological receptors may be impacted upon and require further consideration:

- River Thames SMINC;
- Vegetation;
- Breeding birds;
- Peregrine Falcons;
- Black redstarts' nests during construction; and
- Bats.

A(1). Revised SBSE version of Malcolm Wells' 1969 Wilderness-Based Checklist

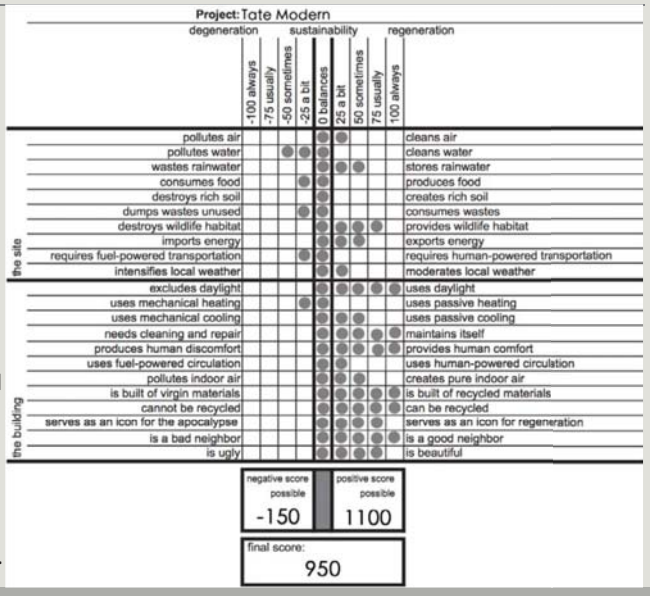
The Site

Air: Only provides 20 parking lots, but provided community garden and other greens to purify the air.
Water: It is a museum with café and restaurant that consume water. Also the toilets produce waste water.
Rainwater: The façade design mitigate the rain that reduce the chance of flooding. There is a cistern tank collects rain water.
Food: Restaurant and Café consumes food, and the site do not produce new food.
Soil: The place was a power plant, but now is a museum.
Waste: There is no system that consume the waste produces.
Habitat: The community garden by Tate is a place friendly for animals. Also during the construction, they nicely considered about bat and other animals.
Energy: Uses PV panels to produce the electricity for the building as well as geothermal.
Fuel: Although they encourage people use less fuel, but still consume it.
Weather: There is not light pollution, heat pollution nor air pollution created by the building. Also the vegetation helps with the weather.



The Building

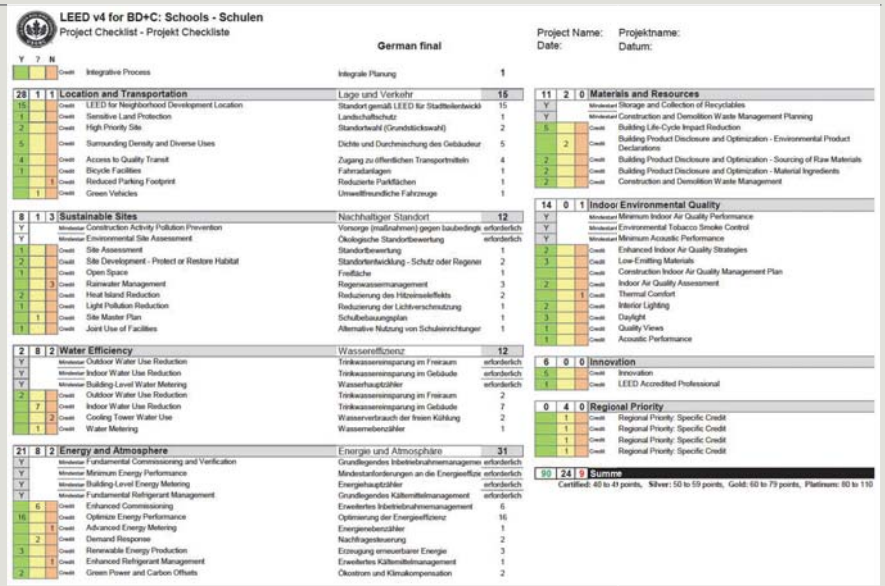
Daylight: The design of the perforated brick façade and window openings allows daylight lighting the space nicely.
Mech. Heating: It uses the geothermal to provide heating, which is very energy efficient.
Mech. Cooling: Due to the cool weather in London, there is not a large amount of cooling needed, and the geothermal can provide good amount of cooling.
Maintenance: The façade material is a low maintenance brick.
Human Comfort: In order to protect the art work inside, the humidity and temperature are in ideal level.
Circulation: It encourage people to use foot traffic and bike.
Indoor Air: There is natural ventilation to improve the air.
Material: Some part of the construction materials are recycled from demolished wastes.
Recycle: The concrete structure and brick are easily recyclable materials.
Icon: It is an important icon in London.
Neighbor: There is no bad effect to the neighbors.
Beautiful: We consider the design form with angle is beautiful.



A(2). Use the LEED checklist to evaluate case study building

LEED Platinum certification!

90 / 110 points
Excellent green building, but still can make some improvements, such as heating strategies and indoor air quality improvement.



LEED v4 for BD+C: Schools - Schulen
Project Checklist - Projekt Checkliste

German final

Project Name: Projektname:
Date: Datum:

Y	?	N				
			Credit	Integrative Process	Integrale Planung	1
28	1	1		**Location and Transportation**	Lage und Verkehr	15
16			Credit	LEED for Neighborhood Development Location	Standort gemäß LEED für Stadtteilentwickl	15
1			Credit	Sensitive Land Protection	Landschaftsschutz	1
2			Credit	High Priority Site	Standortwahl (Grundstückswahl)	2
5			Credit	Surrounding Density and Diverse Uses	Dichte und Durchmischung des Gebäudeur	5
4			Credit	Access to Quality Transit	Zugang zu öffentlichen Transportmitteln	4
1			Credit	Bicycle Facilities	Fahrradanlagen	1
		1	Credit	Reduced Parking Footprint	Reduzierte Parkflächen	1
1			Credit	Green Vehicles	Umweltfreundliche Fahrzeuge	1
8	1	3		**Sustainable Sites**	Nachhaltiger Standort	12
Y			Mindestst	Construction Activity Pollution Prevention	Vorsorge (maßnahmen) gegen baubedingte	erforderlich
Y			Mindestst	Environmental Site Assessment	Ökologische Standortbewertung	erforderlich
1			Credit	Site Assessment	Standortbewertung	1
2			Credit	Site Development - Protect or Restore Habitat	Standortentwicklung - Schutz oder Regener	2
1			Credit	Open Space	Freifläche	1
		3	Credit	Rainwater Management	Regenwassermanagement	3
2			Credit	Heat Island Reduction	Reduzierung des Hitzeinseleffekts	2
1			Credit	Light Pollution Reduction	Reduzierung der Lichtverschmutzung	1
	1		Credit	Site Master Plan	Schulbebauungsplan	1
1			Credit	Joint Use of Facilities	Alternative Nutzung von Schuleinrichtunger	1
2	8	2		**Water Efficiency**	Wassereffizienz	12
Y			Mindestst	Outdoor Water Use Reduction	Trinkwassereinsparung im Freiraum	erforderlich
Y			Mindestst	Indoor Water Use Reduction	Trinkwassereinsparung im Gebäude	erforderlich
Y			Mindestst	Building-Level Water Metering	Wasserhauptzähler	erforderlich
2			Credit	Outdoor Water Use Reduction	Trinkwassereinsparung im Freiraum	2
7			Credit	Indoor Water Use Reduction	Trinkwassereinsparung im Gebäude	7
	2		Credit	Cooling Tower Water Use	Wasserverbrauch der freien Kühlung	2
1			Credit	Water Metering	Wassernebenzähler	1
21	8	2		**Energy and Atmosphere**	Energie und Atmosphäre	31
Y			Mindestst	Fundamental Commissioning and Verification	Grundlegendes Inbetriebnahmemanagemer	erforderlich
Y			Mindestst	Minimum Energy Performance	Mindestanforderungen an die Energieeffizie	erforderlich
Y			Mindestst	Building-Level Energy Metering	Energiehauptzähler	erforderlich
Y			Mindestst	Fundamental Refrigerant Management	Grundlegendes Kältemittelmanagement	erforderlich
	6		Credit	Enhanced Commissioning	Erweitertes Inbetriebnahmemanagement	6
16			Credit	Optimize Energy Performance	Optimierung der Energieeffizienz	16
		1	Credit	Advanced Energy Metering	Energienebenzähler	1
	2		Credit	Demand Response	Nachfragesteuerung	2
3			Credit	Renewable Energy Production	Erzeugung erneuerbarer Energie	3
		1	Credit	Enhanced Refrigerant Management	Erweitertes Kältemittelmanagement	1
2			Credit	Green Power and Carbon Offsets	Ökostrom und Klimakompensation	2

11	2	0		**Materials and Resources**
Y			Mindestst	Storage and Collection of Recyclables
Y			Mindestst	Construction and Demolition Waste Management Planning
5			Credit	Building Life-Cycle Impact Reduction
	2		Credit	Building Product Disclosure and Optimization - Environmental Product Declarations
2			Credit	Building Product Disclosure and Optimization - Sourcing of Raw Materials
2			Credit	Building Product Disclosure and Optimization - Material Ingredients
2			Credit	Construction and Demolition Waste Management
14	0	1		**Indoor Environmental Quality**
Y			Mindestst	Minimum Indoor Air Quality Performance
Y			Mindestst	Environmental Tobacco Smoke Control
Y			Mindestst	Minimum Acoustic Performance
2			Credit	Enhanced Indoor Air Quality Strategies
3			Credit	Low-Emitting Materials
			Credit	Construction Indoor Air Quality Management Plan
2			Credit	Indoor Air Quality Assessment
	1		Credit	Thermal Comfort
2			Credit	Interior Lighting
3			Credit	Daylight
1			Credit	Quality Views
1			Credit	Acoustic Performance
6	0	0		**Innovation**
5			Credit	Innovation
1			Credit	LEED Accredited Professional
0	4	0		**Regional Priority**
	1		Credit	Regional Priority: Specific Credit
	1		Credit	Regional Priority: Specific Credit
	1		Credit	Regional Priority: Specific Credit
	1		Credit	Regional Priority: Specific Credit
90	24	9		**Summe**

Certified: 40 to 49 points, Silver: 50 to 59 points, Gold: 60 to 79 points, Platinum: 80 to 110

A(3). Summarize how well case study building achieves its sustainability goals

According to above analysis, We could see The Tate Modern has already been an excellent building. But there still have some parts need to be improved.

In terms of site, the main issues are including: not doing well on regenerate clean air and water, no strategies for black water, not doing well insulation, consuming food and waste.
In terms of building, the main issues are including: indoor air quality and passive heating.

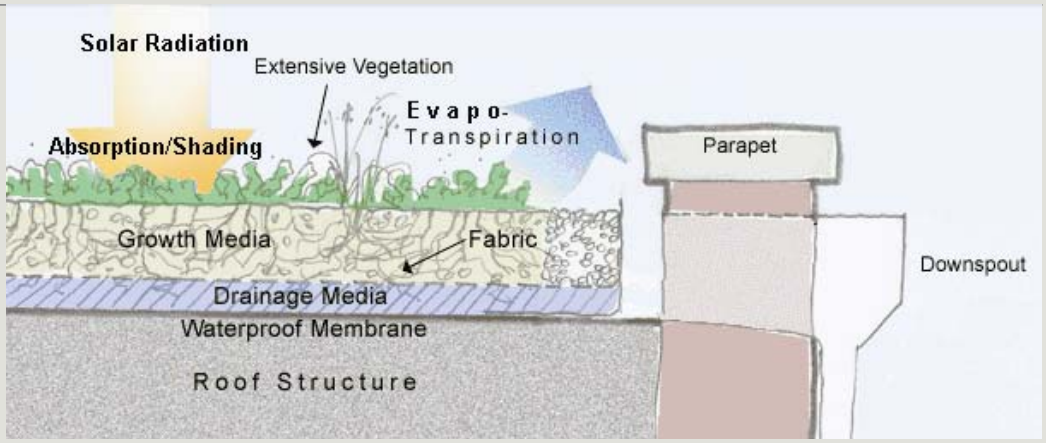
By revised SBSE version of Malcolm Wells' Checklist, the Tate Modern could meets almost points. After our Calculate, the positive score of Tate Modern is 1100, Negative score is -150, and the final score is 950.

Besides, by LEED checklist, the Tate Modern still has a good score that is 90/110.

Finally, we are going to improve some parts in terms of green roof, dumps wastes and indoor air as well as passive heating.

Building Redesign QuestionB-REDESIGN PROPOSAL-Green Roof

Goal: Better Moderate Local Weather

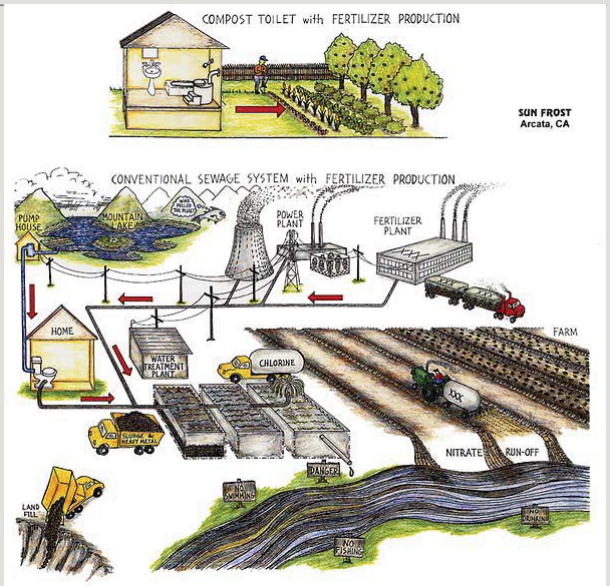


In order to mitigate the heat island effect and contribute to the weather of the site, the building could use green roof or outdoor green walls. Using the vegetation requires low maintenance is the key. If the vegetation can improve the air quality, it will be better!

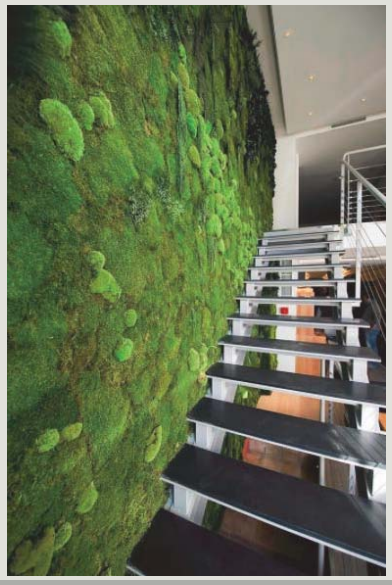
REDESIGN PROPOSAL-Dumps Wastes

Goals: Reduce Water Usage and Black Water, Consume Waste, Create Rich Soil and Produce Food

Replacing all toilets to composing toilet and use grey water for urinal can reduce of the amount of black water producing on site.
Also, the nutrition from the waste can be used as fertilizer for the community garden for food producing. At the same time, these can enrich the soil.



REDESIGN PROPOSAL-Indoor Air



Goals: Improves Indoor Air Quality

Although the air handling units has the filters to purify the indoor air, but in order to improve the air quality and creates more fresh air, the indoor green wall can be a good option.
Also, gray water from washing hands can be used on the green wall irrigation to help to reuse water.

REDESIGN PROPOSAL-Passive Heating

Passive Solar Heating Strategies

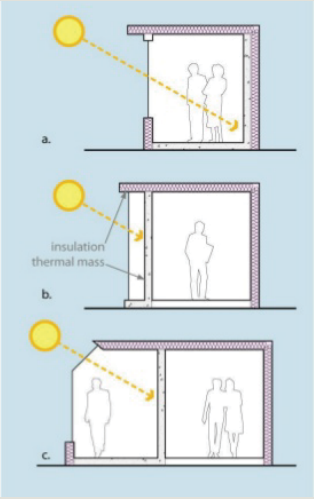
3 MAIN STRATEGIES:

a. Direct Gain

b. Thermal Storage Wall

c. Sunspace

The dominant architectural choice is Direct Gain.



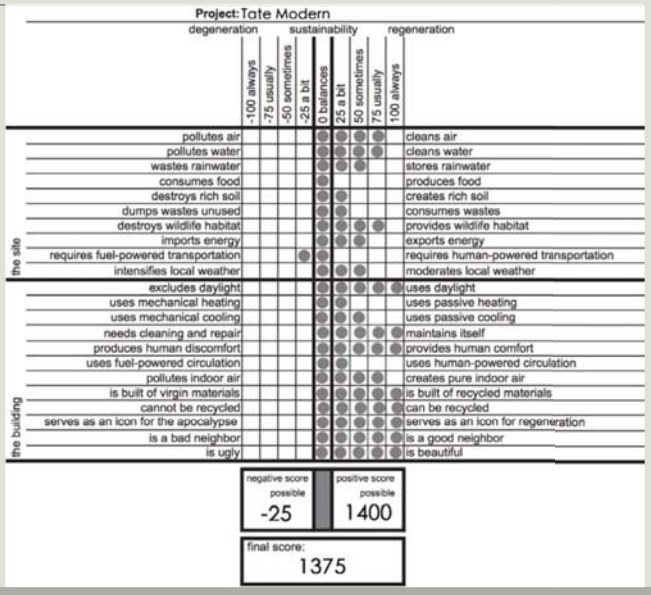
Goals: Improve the heating strategy

London it has a climate that required little cooling but a large amount of heating. Passive heating strategies are important for the energy conservation. By adding thermal mass for heat gain or add sun space can achieve the passive heating goal.
In addition, the tower of Tate modern is not well insulated. Adding good insulation can also help with the heating aspect.

B(2). REDESIGN – MALCOLM WELLS' CHECKLIST

Redesign focused on four major parts:
Green roof
Dumps wastes
Indoor air
Passive heating

Finally, the positive score increased from 1100 to 1400. The negative score decreased from -150 to -25. The finally score increased from 950 to 1375. That's a good improvement.



Project: Tate Modern

	degeneration				sustainability				regeneration	
	-100 always	-75 usually	-50 sometimes	-25 a bit	0 balances	25 a bit	50 sometimes	75 usually	100 always	
the site					●	●	●	●		pollutes air / cleans air
					●	●	●	●		pollutes water / cleans water
					●	●	●			wastes rainwater / stores rainwater
					●					consumes food / produces food
					●	●				destroys rich soil / creates rich soil
					●	●				dumps wastes unused / consumes wastes
					●	●	●	●		destroys wildlife habitat / provides wildlife habitat
					●	●	●			imports energy / exports energy
				●	●					requires fuel-powered transportation / requires human-powered transportation
					●	●	●			intensifies local weather / moderates local weather
the building					●	●	●	●	●	excludes daylight / uses daylight
					●	●				uses mechanical heating / uses passive heating
					●	●	●			uses mechanical cooling / uses passive cooling
					●	●	●	●	●	needs cleaning and repair / maintains itself
					●	●	●	●	●	produces human discomfort / provides human comfort
					●	●				uses fuel-powered circulation / uses human-powered circulation
					●	●	●	●		pollutes indoor air / creates pure indoor air
					●	●	●	●	●	is built of virgin materials / is built of recycled materials
					●	●	●	●	●	cannot be recycled / can be recycled
					●	●	●	●	●	serves as an icon for the apocalypse / serves as an icon for regeneration
					●	●	●	●	●	is a bad neighbor / is a good neighbor
					●	●	●	●	●	is ugly / is beautiful

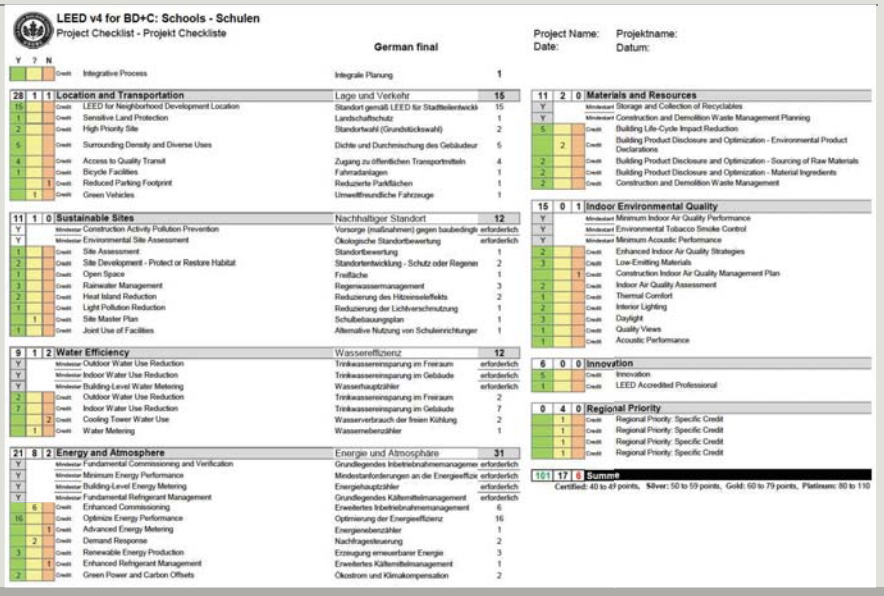
negative score possible	positive score possible
-25	1400

final score: 1375

B(2). REDESIGN – LEED CHECKLIST

Redesign focus on the passive heating strategies, indoor air quality improvement and waste management.

Point increase from 90-101, increase of 11 points!



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Date: Datum:

Y	?	N				
			Credit	Integrative Process	Integrale Planung	1
28	1	1	**Location and Transportation**	Lage und Verkehr		15
15			Credit	LEED for Neighborhood Development Location	Standort gemäß LEED für Stadtteilentwickl	15
1			Credit	Sensitive Land Protection	Landschaftsschutz	1
2			Credit	High Priority Site	Standortwahl (Grundstückswahl)	2
5			Credit	Surrounding Density and Diverse Uses	Dichte und Durchmischung des Gebäudeur	5
4			Credit	Access to Quality Transit	Zugang zu öffentlichen Transportmitteln	4
1			Credit	Bicycle Facilities	Fahrradanlagen	1
		1	Credit	Reduced Parking Footprint	Reduzierte Parkflächen	1
		1	Credit	Green Vehicles	Umweltfreundliche Fahrzeuge	1
11	1	0	**Sustainable Sites**	Nachhaltiger Standort		12
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Y			Mindestan	Environmental Site Assessment	Ökologische Standortbewertung	erforderlich
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2			Credit	Site Development - Protect or Restore Habitat	Standortentwicklung - Schutz oder Regener	2
1			Credit	Open Space	Freifläche	1
3			Credit	Rainwater Management	Regenwassermanagement	3
2			Credit	Heat Island Reduction	Reduzierung des Hitzeinseleffekts	2
1			Credit	Light Pollution Reduction	Reduzierung der Lichtverschmutzung	1
	1		Credit	Site Master Plan	Schulbebauungsplan	1
1			Credit	Joint Use of Facilities	Alternative Nutzung von Schuleinrichtunger	1
9	1	2	**Water Efficiency**	Wassereffizienz		12
Y			Mindestan	Outdoor Water Use Reduction	Trinkwassereinsparung im Freiraum	erforderlich
Y			Mindestan	Indoor Water Use Reduction	Trinkwassereinsparung im Gebäude	erforderlich
Y			Mindestan	Building-Level Water Metering	Wasserhauptzähler	erforderlich
2			Credit	Outdoor Water Use Reduction	Trinkwassereinsparung im Freiraum	2
7			Credit	Indoor Water Use Reduction	Trinkwassereinsparung im Gebäude	7
	2		Credit	Cooling Tower Water Use	Wasserverbrauch der freien Kühlung	2
1			Credit	Water Metering	Wasserverbrauch der freien Kühlung	1
21	8	2	**Energy and Atmosphere**	Energie und Atmosphäre		31
Y			Mindestan	Fundamental Commissioning and Verification	Grundlegendes Inbetriebnahmemanagemen	erforderlich
Y			Mindestan	Minimum Energy Performance	Mindestanforderungen an die Energieeffizie	erforderlich
Y			Mindestan	Building-Level Energy Metering	Energiehauptzähler	erforderlich
Y			Mindestan	Fundamental Refrigerant Management	Grundlegendes Kältemittelmanagement	erforderlich
	6		Credit	Enhanced Commissioning	Erweitertes Inbetriebnahmemanagement	6
16			Credit	Optimize Energy Performance	Optimierung der Energieeffizienz	16
	1		Credit	Advanced Energy Metering	Energiezähler	1
	2		Credit	Demand Response	Nachfragesteuerung	2
3			Credit	Renewable Energy Production	Erzeugung erneuerbarer Energie	3
	1		Credit	Enhanced Refrigerant Management	Erweitertes Kältemittelmanagement	1
2			Credit	Green Power and Carbon Offsets	Ökostrom und Klimakompensation	2

11	2	0	**Materials and Resources**	
Y			Mindestan	Storage and Collection of Recyclables
Y			Mindestan	Construction and Demolition Waste Management Planning
5			Credit	Building Life-Cycle Impact Reduction
	2		Credit	Building Product Disclosure and Optimization - Environmental Product Declarations
2			Credit	Building Product Disclosure and Optimization - Sourcing of Raw Materials
2			Credit	Building Product Disclosure and Optimization - Material Ingredients
2			Credit	Construction and Demolition Waste Management
15	0	1	**Indoor Environmental Quality**	
Y			Mindestan	Minimum Indoor Air Quality Performance
Y			Mindestan	Environmental Tobacco Smoke Control
Y			Mindestan	Minimum Acoustic Performance
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3			Credit	Low-Emitting Materials
	1		Credit	Construction Indoor Air Quality Management Plan
2			Credit	Indoor Air Quality Assessment
1			Credit	Thermal Comfort
2			Credit	Interior Lighting
3			Credit	Daylight
1			Credit	Quality Views
1			Credit	Acoustic Performance
6	0	0	**Innovation**	
5			Credit	Innovation
1			Credit	LEED Accredited Professional
0	4	0	**Regional Priority**	
	1		Credit	Regional Priority: Specific Credit
	1		Credit	Regional Priority: Specific Credit
	1		Credit	Regional Priority: Specific Credit
	1		Credit	Regional Priority: Specific Credit
101	17	6	**Summe**	

Certified: 40 to 49 points, Silver: 50 to 59 points, Gold: 60 to 79 points, Platinum: 80 to 110

B(3). Summarize how well redesigned case study building now achieves its sustainability goals

According to redesign, the Tate Modern could be a better building in terms of sustainability.

In terms of site, the main improvements are including: create clean air & water, reduce and recycle dumps wastes, mitigate the local weather.
These changes will improve local weather. Besides, these changes will reduce water usage, treat black water, and consume waste as well as create rich soil and produce food.

In terms of building, the main improvements are including: indoor air quality improvement and passive heating.
These changes will improve indoor air quality and improve the passive heating strategy.

After redesign, by revised SBSE version of Malcolm Wells' Checklist, the positive score of Tate Modern is 1400, Negative score is -25, and the final score is 1375.

Besides, by LEED checklist, the Tate Modern has a better score that is 101/110.

Conclusion

According to performance analysis of Tate Modern and redesign. Although the Tate Modern has already been a good building in terms of sustainability. But there are still have some parts need to be improved, such as, Green roof, Dumps wastes, and Indoor air as well as Passive heating. By all of those improvements, we are able to see the changes of score.

MALCOLM WELLS' CHECKLIST: finally score increased from 950 to 1375.

LEED CHECKLIST: score increased from 90 to 101.