UNIVERSITI TEKNOLOGI MARA
College of Built Environment

Poster Book

IIIDBEEX 2023

20 JANUARY 2023

International Invention, Innovation & Design Exposition for Built Environment and Engineering 2023

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CONTENTS

SIMULATION ON DAYLIGHTING PENETRATION INTO BUILDING ATRIUM FOR ARTIFICIAL INTELLIGENCE INTEGRATED FARMING

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Universiti Teknologi MARA — College of Built Environment (CBE)

INTRODUCTION


Source: https://matadornetwork.com/change/26-futuristic-urban-farms/


Source: https://edition.cnn.com/2012/12/09/business/eco-singapore-vertical-farm/index.html


Source: https://www.inc.com/magazine/202110/bill-saporito/vertical-urban-farming-future-agriculture-startup.html

What?

Urban farming is characterised as mostly taking place in a community within a city or other densely populated urban settings. Contemporary urban farming is usually done inside a building with an atrium, for direct sunlight penetration for plants

Why?

Malaysia's food crisis highlights how fragile the supply chains for everyday items can be in times of crisis. In order to feed the world in the future, there needs to be new solutions for food supply - urban farming is one such solution.

How?

In order to fully maximise the sunlight penetration within a tropical country, an atrium design must be fully efficient. With the help of A.I sensors integration with the farming system, an atrium can be designed to maximise the daylight penetration.

ISSUES/ PROBLEM STATEMENT

Scarcity of Land + Low food supply

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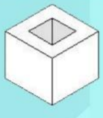
Urban Farming

↓

Indoor

Inefficient atrium design ← Indoor → Low daylight penetration



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A.I Integrated Farming

↓

Improve agriculture

OBJECTIVES

a) To analyse what are the characteristic, benefits and limitations of atrium design.

b) To study different types of typologies of atrium design in tropical climate

c)To simulate the atrium design based on the criteria provided.

METHODOLOGY

PRIMARY DATA

Simulation will simulate three models:-

1) Atrium design with long horizontal opening,
2) Atrium design with square opening,
3) Atrium design with centralised and circular opening

All three models are to be simulated with illuminance and amount of daylight penetration under tropical climate environment.

Date: 21 March, 21 Jun, 21 Sept, 21 Dec, Time: 8am-5pm (1 hour intervals)

Simulation Process Analysis: Sketchup -> Lighstanza-> Data Tabulations

SECONDARY DATA

Literature review focused on the keywords; urban farming, artificial intelligence, tropical climate, atrium design. This will give a better understanding of different types of atrium design and also the benefits, characteristics and limitations. It will also help to decide the type of atrium design to be simulated

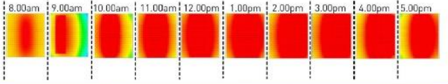
Step 1	Step 2	Step 3	Step 4	Step 5
Define the objective of the simulation	Determine the criteria that needs to be simulated	Modelling in Sketchup 2022	Simulation procedure in Lightstanza	Collect and interpret the data collection
↓	↓	↓	↓	↓
To find the best design of atrium that allows efficient daylight penetration	1) long horizontal opening, 2) Square opening, 3) centralised and circular opening	Modelling process occurs based on the criteria provided by literature review	Model is downloaded into Lighstanza and simulated with the variables set	Data collection and analysis to form findings and conclusion

FINDINGS

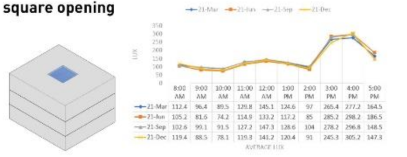
Atrium design with long horizontal opening

	8:00 AM	9:00 AM	10:00 AM	11:00 AM	12:00 AM	1:00 PM	2:00 PM	3:00 PM	4:00 PM	5:00 PM
21-Mar	366.4	344.4	135	129.8	275.7	156	204.6	431.2	944.7	515.7
21-Jun	313.6	304.3	262.9	185.3	162.2	243.5	308.2	647.9	870.3	389.9
21-Sep	312.4	234.1	250.2	148.3	336.2	159.6	250.8	749.3	951.5	316.5
21-Dec	292	325.1	242.3	194.4	240.2	249.9	610.8	657.9	659.1	256.4

Daylight Penetration Distribution on plan

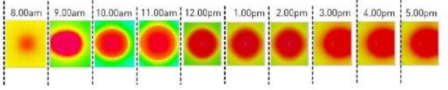


Atrium design with square opening



	8:00 AM	9:00 AM	10:00 AM	11:00 AM	12:00 AM	1:00 PM	2:00 PM	3:00 PM	4:00 PM	5:00 PM
21-Mar	112.4	96.4	89.5	129.8	145.1	124.6	97	265.4	277.2	164.5
21-Jun	105.2	81.6	74.2	114.9	133.2	117.2	85	285.2	298.2	186.5
21-Sep	102.6	99.1	91.5	127.2	147.3	128.6	104	278.2	296.8	148.5
21-Dec	119.4	88.5	78.1	119.3	141.2	120.4	91	245.3	305.2	147.3

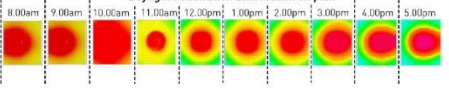
Daylight Penetration Distribution on plan



Atrium design with centralised, circular opening

	8:00 AM	9:00 AM	10:00 AM	11:00 AM	12:00 AM	1:00 PM	2:00 PM	3:00 PM	4:00 PM	5:00 PM
21-Mar	394.2	375.6	258.6	338.2	421.5	496.3	386.4	428.1	562.1	485.6
21-Jun	351.4	332.8	312.6	324.6	398.7	465.8	415.2	634.7	425.3	354
21-Sep	349.2	264.5	280.7	314.8	527.2	586.1	510.4	668.5	574.1	294.8
21-Dec	313.5	358.9	277.6	372.5	457.2	514.3	589.6	657.9	659.1	248.1

Daylight Penetration Distribution on plan



- The characteristics of atrium design is that it can be used to provide adequate daylight, circulation of spaces and surfaces for landscape applications. The benefits of the design is that it can reduce electrical consumption of the building and provide central area, while the limitations of atrium design are excessive daylight from inefficent design, glare and high temperature from tropical climate.
- According to the secondary data, these are the common 6 typlogy of atrium design that can be identified and found across the tropical climate, which are:-1) Centralised, 2) Semi enclosed, 3) Attached, 4) Linear, 5) Long horizontal opening and 6) Centralized Circular
- From the simulation, the circular shaped atrium is found top be the most efficient in the sense of daylight penetration, followed by the long horizontal atrium and the square opening atrium

NOVELTY

In order to design a better atrium that enables improvement of precise projected agricultural produce based on the optimal lighting conditions of indoor farming, the principle of simulating lighting in buildings can be integrated with artificial intelligence to create a more effective design.

RECOGNITIONS

KEMENTERIAN TENAGA, TEKNOLOGI, SAINS, PERUBAHAN IKLIM & ALAM SEKITAR

Suruhanjaya Tenaga Energy Commission

SIRIM

CONCLUSION

In conclusion, the circular-shaped atrium is found to be preferable for atrium design in tropical climate due to more daylight penetration and distribution, compared to rectangular-shaped atrium and the square opening atrium. Therefore, it can be inferred as a recommended typology of atrium design for a.i integrated urban farming, which satisfy the study's aim and objective.

COMMERCIALIZATION

Potential →
- Guidelines on atrium design
- New form of design products for A.I urban farming
- Specialization of atrium industry

CONFERENCES & PUBLICATION

emerald insight — Discover Journals, Books & Case Studies

UNIVERSITI MALAYA

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