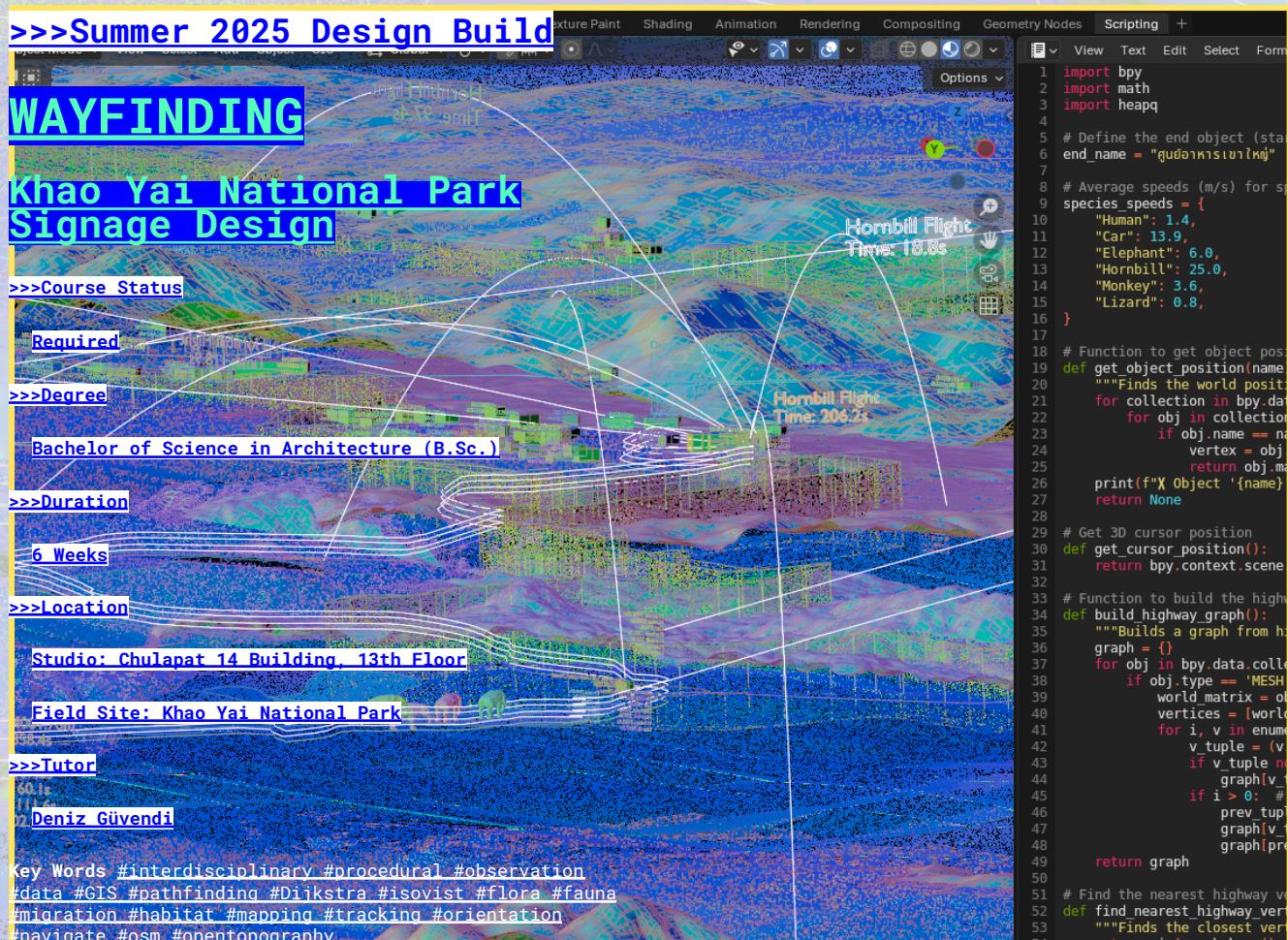


Distance: 450
Human: 285s
Car: 287.9s
Elephant: 667s
Hornbill: 160s



>>>Summer 2025 Design Build

WAYFINDING

Khao Yai National Park Signage Design

>>>Course Status
Required

>>>Degree
Bachelor of Science in Architecture (B.Sc.)

>>>Duration
6 Weeks

>>>Location
Studio: Chulaprat 14 Building, 13th Floor
Field Site: Khao Yai National Park

>>>Tutor
SOI
Deniz Güvendi

Key Words #interdisciplinary #procedural #observation
#data #GIS #pathfinding #Dijkstra #isovist #flora #fauna
#migration #habitat #mapping #tracking #orientation
#navigate #osm #openstreetmap

```

1 import bpy
2 import math
3 import heapq
4
5 # Define the end object (station)
6 end_name = "สถานีสุดท้าย"
7
8 # Average speeds (m/s) for species
9 species_speeds = {
10     "Human": 1.4,
11     "Car": 13.9,
12     "Elephant": 6.0,
13     "Hornbill": 25.0,
14     "Monkey": 3.6,
15     "Lizard": 0.8,
16 }
17
18 # Function to get object position
19 def get_object_position(name):
20     """Finds the world position of an object by name"""
21     for collection in bpy.data.collections:
22         for obj in collection.objects:
23             if obj.name == name:
24                 vertex = obj.matrix_world.to_translation()
25                 return obj.matrix_world.to_translation()
26     print(f"Object '{name}' not found")
27     return None
28
29 # Get 3D cursor position
30 def get_cursor_position():
31     return bpy.context.scene.cursor.location
32
33 # Function to build the highway graph
34 def build_highway_graph():
35     """Builds a graph from highway vertices"""
36     graph = {}
37     for obj in bpy.data.collections[0].objects:
38         if obj.type == 'MESH' and obj.name != 'Highway':
39             world_matrix = obj.matrix_world
40             vertices = [world_matrix @ v.co for v in obj.data.vertices]
41             for i, v in enumerate(vertices):
42                 v_tuple = (v.x, v.y, v.z)
43                 if v_tuple not in graph:
44                     graph[v_tuple] = []
45                 if i > 0:
46                     prev_tuple = (vertices[i-1].x, vertices[i-1].y, vertices[i-1].z)
47                     if prev_tuple in graph:
48                         graph[prev_tuple].append(v_tuple)
49     return graph
50
51 # Find the nearest highway vertex
52 def find_nearest_highway_vertex(target):
53     """Finds the closest vertex to a target point"""
54     min_dist = float('inf')
55     closest_vertex = None
56     for vertex in graph:
57         dist = ((vertex[0] - target[0]) ** 2 + (vertex[1] - target[1]) ** 2 + (vertex[2] - target[2]) ** 2) ** 0.5
58         if dist < min_dist:
59             min_dist = dist
60             closest_vertex = vertex
61     return closest_vertex
62
63 # Find the shortest path between two points
64 def find_shortest_path(start, end):
65     """Finds the shortest path between two points using Dijkstra's algorithm"""
66     graph = build_highway_graph()
67     start_vertex = find_nearest_highway_vertex(start)
68     end_vertex = find_nearest_highway_vertex(end)
69     if start_vertex is None or end_vertex is None:
70         return []
71     distances = {vertex: float('inf') for vertex in graph}
72     distances[start_vertex] = 0
73     previous = {vertex: None for vertex in graph}
74     queue = [(0, start_vertex)]
75     while queue:
76         current_dist, current_vertex = heapq.heappop(queue)
77         if current_vertex == end_vertex:
78             break
79         for neighbor in graph.get(current_vertex, []):
80             distance = current_dist + 1
81             if distance < distances[neighbor]:
82                 distances[neighbor] = distance
83                 previous[neighbor] = current_vertex
84                 heapq.heappush(queue, (distance, neighbor))
85     path = []
86     current = end_vertex
87     while current is not None:
88         path.append(current)
89         current = previous[current]
90     path.reverse()
91     return path
92
93 # Main function to find the path
94 def find_path(start, end):
95     """Finds the path between two points using the shortest path algorithm"""
96     path = find_shortest_path(start, end)
97     return path
98
99 # Example usage
100 start = (30, 40, 0)
101 end = (50, 60, 0)
102 path = find_path(start, end)
103 print(path)

```

Course Description

"In the time of adaptation, architecture needs to draw on all forms of intelligence—natural, artificial, collective."

— Carlo Ratti, Venice Architecture Biennale 2025
Intelligens. Natural. Artificial. Collective.

Wayfinding is not just about navigation—it is a system that orchestrates movement, clarity, and spatial experience. As behaviors in navigation shift and environmental conditions change, signage must evolve into an intelligent, adaptive, and context-aware system. While digital navigation alters how we interact with spaces, physical wayfinding remains critical—shaping perception, guiding movement, and integrating into the material environment.

The course will explore wayfinding and signage for Khao Yai Park starting with spatial analysis, behavioral mapping, and material optimization, integrating Blender GIS, Houdini,

and later Rhinoceros for a transition from large-scale mapping to fabrication-ready signage. The first half of the course establishes a structured framework for research, computational modeling, and environmental integration. The second half shifts towards individualized workflows, where students develop their own strategies and fabrication approaches within a collective system of navigation design.

Learning Objectives

>>> Develop an adaptive and analytical approach to wayfinding, integrating spatial research, computational methods, and material efficiency.

>>> Apply pathfinding and material optimization algorithms

>>> Design, fabricate, and implement signage prototypes that are contextually integrated and

data driven.

>>> Use Blender GIS, Houdini, and Rhino as a sequential workflow, transitioning from data analysis to physical fabrication. (Basic knowledge of Rhinoceros required)

>>> Learn the workflow from conceptualization to fabrication and on-site installation

>>> Develop concept sketches, models, and visualizations.

>>> Explore material possibilities that align with the context.

>>> Test digital and physical prototypes to refine design solutions. (1:50 / 1:5 / 1:1)

Phase 3: Fabrication & Materialization (Weeks 5-6)

INDIVIDUAL/MAX.2

>>> Developing site-specific wayfinding concepts, integrating ecological considerations and adaptive navigation strategies.

>> Prototyping (1:20/1:50)

>>> Preparing fabrication-ready models and documentation, ensuring precision in placement, material selection, and assembly.

>>> Deploying signage prototypes at strategic locations, testing and refining real-world user interactions.

>>> Produce 1:1 scale prototypes /mixed techniques.

>>> Install the sign

>>> Conduct visitor testing (Exhibition) (1:1)

Project Phases

The course is divided into four phases, leading from research to 1:1 implementation.

Phase 1: Research & Data Collection (Weeks 1-2)

GROUP WORK

- >>> Conduct field studies to observe visitor behavior, ecological features, and existing signage.
- >>> Collect data (textures, environmental patterns, spatial organization) and other useful tools ex. Photogrammetry tools.
- >>> Mapping terrain, movement flows, and ecological features using GIS datasets, OpenStreetMap, Google Maps, and OpenTopography.
- >>> Analyzing user and non-human navigation patterns, capturing textures and spatial organization, and rebuilding.

(1:2000/1:200)

Phase 2: Concept Development (Weeks 3-4)

GROUP & INDIVIDUAL

- >>> Signage inventory group work > Defining signage typologies, typography, and spatial positioning within the environment.
- >>> Documenting and analyzing existing signage posts to assess material composition and reuse potential.
- >>> Applying the Hungarian Algorithm to optimize material redistribution and reduce unnecessary interventions.
- >>> Developing material-conscious design strategies, aligning wayfinding interventions with site-specific resources.
- >>> Select individual themes based on ecological and spatial observations.

Schedule

Week		
Week 1 – Research & Data Collection	Course Introduction & Research Scope	
	Fieldwork Preparation: Assign research roles, equipment setup	
	Field Study Trip to Khao Yai	Collect data, analyze terrain, document existing signage
	Existing Signage Documentation	Assess material reuse

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		potential		
	GIS Data Processing			
	Pathfinding Algorithm Introduction	Dijkstra's shortest path & movement logic		
	Navigation & Behavioral Analysis	Studying movement patterns		
	Mapping Navigation Flows	Analyzing terrain constraints & visitor routes		
	Preliminary Theme & Concept Development	Material intervention strategies		
Week 2 - Data Analysis & Concept Development	Group Work – Signage Inventory	Phase 2-Introduction		
	Finalizing GIS & Terrain Data	Houdini-based navigation simulations		
	Hungarian Algorithm for Material Optimization	Upcycling signage material inventory		
	Material Inventory Analysis	Evaluating available resources		
	Typology, font selection, spatial positioning			
	Computational Design Refinement	Algorithm-driven placement adjustments		
	Developing Wayfinding Signage	Integrating AI, GIS, and user behavior		
	Group Review & Refinement			
Week 3 - Concept Refinement	Digital Prototypes			
	Environmental Adaptation Review	Adjusting signs to ecological context		
	Digital Prototype Refinements	Ensuring visibility & material feasibility		
	Hungarian			
			Algorithm for Material Redistribution	
			Signage Placement & Orientation Adjustments	Testing field effectiveness
			Font & Visual Communication Strategy	Legibility testing in context
			Algorithmic Placement Validation	Running spatial simulations
			Pre-Production Testing	Evaluating material efficiency
			Group Review & Refinement	Iteration of final strategies
			Week 4 - Fabrication Planning & Refinement	
			Making Models	
			Refining Digital Prototypes	Adjustments before fabrication
			Signage Integration Testing	Preparing for real-world installation
			Assembly Feasibility Review	Assessing construction strategies
			Material Adaptation & Refinement	Ensuring structural stability
			Finalizing Site Placement Details	Precision adjustments
			Pre-Installation Preparation	Ensuring signage durability
			Weather-Resistance Testing	Ensuring longevity
			Final Documentation & Presentation Prep	Organizing research insights
			Week 5 - 1:1 Scale Fabrication & Assembly	
			Fabrication	
			Signage Detail Refinement	Precision assembly checks
			Pre-Installation Testing	Final prototype review

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	Structural Reinforcement & Assembly	Preparing for on-site conditions
	Final Adjustments Before Installation	Ensuring field compatibility
Week 6 – Installation, Testing & Final Review	On-Site Installation	
	User Interaction Documentation	Observing movement response
	Testing	Refinements based on real-world conditions
	Team Critique & Adjustments	Refining based on feedback
	Final Exhibition	Reviewing the project process
	Submission: Documentation	Presenting research & fabrication outcomes

Deliverables

>>> **Documentation:** Research Driven Design – Data analysis, ecological observations, and thematic studies. (1/2000 - 1/200)

>>> **Design Proposal** – Concept sketches, models, prototypes (1/200 - 1/20)

>>> **Fabricated Prototype** – 1:1 scale wayfinding sign exhibited.

>>> **Final Presentation** – Showcasing the design process, material experimentation, and environmental integration.

Tools & Resources

Software: Rhinoceros 7/8, Houdini 20.5 Labs, Blender, GIS add-on, Python 3.12.

Materials: Timber, Steel, recycled metal, biodegradable composites, Concrete (determined per project).

Field Equipment: GPS devices, environmental sensors, cameras, and phones.

Budget

Given fabrication budget: **10,000–20,000 THB per student** –depending on material choices and fabrication complexity. Materials and Construction, Transportation, Delivery Service – Renting Equipment, Printing poster, and booklet are included in the budget/student.

References

1. Forensic Architecture – Tracking Environmental Violence (2022)
2. MIT Senseable City Lab – Treepedia (2020)
3. Bestiary of the Anthropocene – Nicholas Nova & Disnovation.org (2021)
4. ScanLAB Projects – Digital Archaeology & Immersive Mapping (2023)
5. Studio Ossidiana – Vondelpark Birdwatching Platforms (2022)
6. SPACE10 – The Digital Wayfinding System (2021)
7. "Interdisciplinary Journal of Signage and Wayfinding", <https://journals.shareok.org/ijsw/ojs/ijsw/issue/archive>
8. <https://www.spaceagency-design.com/#/spaceagency-guide-to-wayfinding/>
9. <https://khaoyainationalpark.com/en/discover>
10. <https://khaoyainationalpark.com/en/discover/flora>

Evaluation Criteria

Research & Analysis (20%) – Depth of environmental understanding & data integration.

Design Development (20%) – Creativity, functionality, and contextual adaptation.

Fabrication & Implementation (40%) – Quality and durability of the prototype.

Documentation & Presentation (20%) – Clarity in conveying research, process, and final outcome.