

An Alternative Rural Housing Management Tool Empowered by A Bayesian Neural Classifier

Supplemental data

S1. Data Collection

Rural housing danger and habitability test form

1. Basic Information				Householder	
Construction time		Name		Phone	
Address					
Housing purpose	<input type="checkbox"/> Residence <input type="checkbox"/> Operating <input type="checkbox"/> Others				
Structure type	<input type="checkbox"/> Raw-soil structure <input type="checkbox"/> Masonry structure <input type="checkbox"/> Stone structure <input type="checkbox"/> Mixed structure <input type="checkbox"/> Others				
Scale	Length:_____m; Width:_____m; Height:_____m; Floor:_____; Area:_____m ² .				
2. Building layout diagram:					
3、Structural component inspection results:					
Danger rating			Habitability rating		
Foundation	<input type="checkbox"/> A <input type="checkbox"/> B <input type="checkbox"/> C <input type="checkbox"/> D		Site environment	<input type="checkbox"/> A <input type="checkbox"/> B <input type="checkbox"/> C	
Wall	<input type="checkbox"/> A <input type="checkbox"/> B <input type="checkbox"/> C <input type="checkbox"/> D		Insulation and waterproof	<input type="checkbox"/> A <input type="checkbox"/> B <input type="checkbox"/> C	
Bonding material	<input type="checkbox"/> A <input type="checkbox"/> B <input type="checkbox"/> C <input type="checkbox"/> D		Fire safety	<input type="checkbox"/> A <input type="checkbox"/> B <input type="checkbox"/> C	
Purlins and roof truss	<input type="checkbox"/> A <input type="checkbox"/> B <input type="checkbox"/> C <input type="checkbox"/> D		Lighting and ventilation	<input type="checkbox"/> A <input type="checkbox"/> B <input type="checkbox"/> C	
Beam and column	<input type="checkbox"/> A <input type="checkbox"/> B <input type="checkbox"/> C <input type="checkbox"/> D		Water and electricity lines	<input type="checkbox"/> A <input type="checkbox"/> B <input type="checkbox"/> C	
Roof and floor	<input type="checkbox"/> A <input type="checkbox"/> B <input type="checkbox"/> C <input type="checkbox"/> D		Sanitary equipment	<input type="checkbox"/> Y <input type="checkbox"/> N	
Reconstruction & expansion	<input type="checkbox"/> Y <input type="checkbox"/> N		Seismic structure	<input type="checkbox"/> Y <input type="checkbox"/> N	
4、Photographs of damage					
Photo 1:			Photo 2:		
Photo 3:			Photo 4:		
5. Comprehensive housing assessment					
Overall risk level	<input type="checkbox"/> A <input type="checkbox"/> B <input type="checkbox"/> C <input type="checkbox"/> D				

Overall Habitable Level	<input type="checkbox"/> A <input type="checkbox"/> B <input type="checkbox"/> C
Evaluation and suggestions	

Reviewer:

Appraisers:

Date:

Table S1 Measuring instrument table for testing

Instrument Name	Model	No.
rebar scanner	PS200S	25608018
laser range finder	DISTO D2	0622734791
steel ruler	0-200mm	8462
steel tape	0-5m	8206
resiliometer	ZC-3	3218055014
instrument of testing mortar-strength	SJY800B	3217052143



(a) Exterior photos of houses



(b) Survey records of house history



(c) Photographing of damage locations



(d) Measurement of housing dimensions

Figure S1 Rural housing detection photos



Figure S2 Field test photos

S2. Specific evaluation criteria

- a. Construction time: before 1980S; from 1980 to 2000; and after 2000S.
- b. Structure type: masonry structure; stone structure; raw-soil structure; others.
- c. Site environment: no natural disasters; natural disasters exist.
- d. Seismic structure: structural measures exist such as ring beams and structural columns; no structural measures.
- e. Foundation: Level A and B: The foundation remained stable without obvious uneven settlement. Level C: The foundation remained stable or slightly damaged. There was a certain amount of uneven settlement, which led to obvious tilt and distortion of the upper structure. Level D: The foundation lost its stability and collapsed.
- f. Wall: Level A: The load-bearing wall was intact without obvious stress cracks. There was no loosening or flashover at the junction of vertical and horizontal walls. Level B: For masonry and stone structures, the walls had no obvious stress cracks. There was no looseness or flashover at the junction of vertical and horizontal walls. For raw-soil structure, there were slight cracks on the wall surface, which did not affect the normal structure. Level C: There were many cracks in the load-bearing wall. The vertical and horizontal walls were obviously cracked and the load-bearing wall was partially crooked. The raw soil wall was severely effloresced and pulverized. Level D: The wall adopted 120mm thick wall to bear the weight. There were multiple vertical cracks in the wall of the masonry structure house with a width greater than 2mm, and the length of the joint exceeded half of the storey height.
- g. Beam and column: Level A: The joints of the beams and columns were connected reliably without obvious deformation and cracks. Level B: For masonry structure, there were multiple vertical cracks in the beam or the width of the crack exceeded 1mm. The column had horizontal cracks due to eccentricity. For raw-soil structure and stone structures, there was no obvious deformation or deflection of the beams and columns. Level C: The beams and columns had different degrees of cracks. The beam and column joints were obviously damaged and cracked but the bearing capacity was not lost. Dislocation of beam-column joints of stone structure houses, slight fractures of stone pillars or stone beams, local stone crushing at the beam ends. There were multiple cracks in the supporting beams of raw soil structure houses or the maximum crack width did not exceed 10mm. Level D: The beams and columns had obvious deflection and flashover, local collapse, severe corrosion and expansion of steel bars. The beam-column joints were seriously damaged, and the maximum crack width exceeded 10mm.
- h. Bonding material: Level A: The bonding material was reliable, the mortar was full and the strength met the requirements. Level B: The bonding material was slightly effloresced and pulverized, which did not affect normal use. Level C: The bonding material was partially missing. Besides, the strength was obviously insufficient. The phenomenon of weathering and pulverization was serious. The stone structure house was partially built with yellow mud,

which had poor cohesiveness. Level D: The house structure had no bonding materials, and the wall was made of stone and blocks.

i. Purlins and roof truss: Level A: The roof truss and purlins had a clear structural system and the components were intact without obvious deformation and cracking. Level B: The purlins and roof truss were locally slightly cracked and the wooden roof truss purlins had slight shrinkage without obvious deformation. Level C: Roof truss purlins were locally bent and deformed; some of them were severely corroded by insects and the length of the purlins was insufficient. Level D: The roof truss purlins were partially missing, severely crooked and partially broken.

j. Roof and floor: Level A: Floor and roof had no obvious deformation and no crack deformation. Level B: There are slight cracks between the roof and the floor. Level C: There were obvious cracks between the roof and the cast-in-situ slab. The bottom of the prefabricated slab appeared horizontally fractured and deformed downward. The roof was partially sunk. Level D: The floor and roof collapsed and fell off.

k. Insulation and waterproof: Level A: The waterproof structure and drainage system were good. The wall had an insulation layer and the insulation was good. Level B: The waterproof structure was basically intact and there was slight aging. The wall had an aging or missing insulation layer. Level C: Inappropriate lack of waterproof structure and thermal insulation, water seepage and rain leakage; serious re-moisture of the wall.

l. Fire safety: Level A: Fire-fighting equipment was equipped indoors, but no flammable and explosive materials were stacked. The water supply function in the house was normal and the fire rescue escape channel met the requirements of fire protection regulations. Level B: There was no fire-fighting equipment indoors. The water supply function was normal, and the fire channel basically met the requirements. Level C: The house was covered with weeds and combustibles. The house lacked fire-fighting equipment and normal water supply functions. Meanwhile, the fire-fighting and rescue channels were so narrow that not suitable for rescue.

m. Lighting and ventilation: Level A: The lighting time and area of the house met the residential design specifications. Natural light was sufficient. The opening position of the room could effectively organize direct circulation with outdoor air. Level B: The lighting time of the house was insufficient and the natural light intensity was insufficient too. Room lighting needed to be used in conjunction with indoor lighting. Indoor air was poor. Level C: The house was dark, without lighting, and indoor air was not circulated.

n. Water and electricity pipelines: Level A: The water and electricity pipelines in the house could be connected normally without aging and damage. Level B: The normal connection of water and electricity pipelines had slight aging phenomenon but it did not affect normal use. Level C: The water and electricity pipelines could not be connected or the water and electricity pipelines were seriously aging. There were water and electricity leakage phenomena.

o. Sanitary equipment: There were certain sanitary equipment (toilet, sink, shower, etc.) in the house. Sanitary equipment was not present in the house.

S3 Model accuracy test

In order to compactly present the test results, 50 random case numbers were extracted from the bank of 206 samples by using ROUND(RAND()*206,0) in Microsoft Excel. The calculated accuracy rate was however based on the whole 206 samples in the bank. In the table, N/A represented that this situation was not applicable to the Bayesian belief network structure model. The reason was that certain combinations of evaluation results concerning habitability were not experienced in the 684 samples for model construction. For example, when house No. 213 was judged, the insulation and waterproof was A, the water and electricity lines were B, the fire safety was C, the lighting and ventilation was A, and the sanitary equipment was no, and the overall habitability level was N/A. Therefore, the Bayesian belief network structure model generated the output result into a default value of 33%/33%/33% for the initial test.

Theoretical test

Table S2: Theoretical test with complete data

NO.	Actual test results		Predicted results %			
	ORL (A/B/C/D)	OHL (A/B/C)	ORL (A/B/C/D)		OHL (A/B/C)	
28	C	C	12.5 / 12.5 / 62.5 / 12.5	√	9.09 / 9.09 / 81.1	√
66	D	C	2.67 / 4.34 / 5.65 / 87.3	√	25.0 / 25.0 / 50.0	√
79	B	C	11.4 / 63.9 / 13.6 / 11.1	√	12.5 / 12.5 / 75.0	√
82	B	B	1.18 / 95.3 / 2.35 / 1.18	√	3.9 / 92.9 / 3.9	√
88	D	B	2.75 / 4.75 / 6.01 / 86.7	√	3.9 / 92.2 / 3.9	√
96	C	B	7.97 / 17.0 / 47.9 / 27.1	√	25.0 / 50.0 / 25.0	√
98	D	B	7.49 / 11.9 / 10.9 / 69.7	√	3.9 / 92.2 / 3.9	√
113	B	B	11.3 / 66.2 / 12.3 / 10.3	√	20.0 / 60.0 / 20.0	√
123	D	C	5.39 / 10.2 / 18.9 / 65.5	√	1.82 / 1.82 / 96.4	√
139	C	B	3.38 / 15.4 / 70.0 / 11.2	√	1.92 / 96.2 / 1.92	√
144	C	C	2.61 / 5.87 / 83.7 / 7.87	√	11.1 / 11.1 / 77.8	√
146	D	C	4.77 / 5.18 / 6.68 / 83.4	√	1.82 / 1.82 / 96.4	√
154	D	C	2.60 / 4.34 / 7.53 / 85.5	√	33.3 / 33.3 / 33.3	N/A
161	B	B	2.31 / 77.0 / 10.8 / 9.88	√	1.59 / 95.2 / 3.17	√
168	D	C	2.63 / 4.2 / 5.65 / 87.7	√	25.0 / 25.0 / 50.0	√
173	C	A	10.8 / 33.2 / 38.5 / 17.5	√	88.9 / 5.56 / 5.56	√
205	B	B	9.14 / 57.6 / 19.2 / 14.0	√	16.7 / 66.7 / 16.7	√
211	B	B	3.09 / 74.4 / 11.9 / 10.6	√	3.9 / 92.2 / 3.9	√
213	B	C	16.5 / 49.8 / 22.8 / 10.9	√	33.3 / 33.3 / 33.3	N/A
215	B	B	2.68 / 71.0 / 13.6 / 12.8	√	1.59 / 95.2 / 3.17	√
228	B	C	2.86 / 68.0 / 15.0 / 14.2	√	7.17 / 7.14 / 85.7	√
235	D	C	5.27 / 5.27 / 14.2 / 75.2	√	11.1 / 11.1 / 78.2	√

247	C	B	2.09 / 13.1 / 80.1 / 4.7	√	1.59 / 95.2 / 3.17	√
254	C	B	2.11 / 5.1 / 87.8 / 5.03	√	3.9 / 92.2 / 3.9	√
260	D	C	5.3 / 5.3 / 20 / 69.4	√	1.82 / 1.82 / 96.4	√
263	D	C	3.14 / 3.14 / 8.22 / 85.0	√	3.57 / 3.57 / 92.9	√
277	D	C	3.13 / 3.17 / 4.39 / 89.3	√	3.03 / 3.03 / 93.9	√
286	D	B	2.73 / 10.0 / 7.33 / 79.9	√	1.59 / 95.2 / 3.17	√
299	D	C	2.3 / 3.59 / 5.69 / 88.4	√	25.0 / 25.0 / 50.0	√
300	B	A	15.1 / 61.2 / 12.5 / 11.3	√	81.8 / 9.09 / 9.09	√
323	D	C	3.5 / 6.38 / 17.9 / 72.2	√	3.33 / 3.33 / 93.3	√
328	D	C	6.62 / 6.62 / 7.78 / 78.6	√	3.57 / 3.57 / 92.9	√
340	D	B	3.39 / 21.6 / 14.9 / 60.2	√	1.59 / 95.2 / 3.17	√
345	C	B	2.11 / 5.10 / 87.8 / 5.03	√	1.59 / 95.2 / 3.17	√
452	B	B	2.23 / 82.5 / 8.20 / 7.05	√	12.5 / 75.0 / 12.5	√
460	D	C	3.9 / 7.1 / 13.0 / 76.0	√	1.82 / 1.82 / 96.4	√
466	D	B	7.32 / 10.2 / 12.2 / 70.3	√	3.9 / 92.2 / 3.9	√
478	C	C	4.72 / 4.72 / 76.7 / 13.8	√	3.33 / 3.33 / 93.3	√
482	D	C	3.94 / 3.98 / 5.17 / 86.9	√	3.03 / 3.03 / 93.9	√
489	C	C	4.94 / 10.3 / 68.4 / 16.4	√	1.82 / 1.82 / 96.4	√
493	D	C	3.13 / 3.17 / 4.39 / 89.3	√	3.57 / 3.57 / 92.9	√
495	D	C	5.23 / 5.30 / 6.42 / 83.1	√	11.1 / 11.1 / 77.8	√
507	B	B	1.66 / 87.9 / 5.78 / 4.69	√	1.59 / 95.2 / 3.17	√
521	D	C	0.02 / 0.02 / 0.02 / 99.9	√	2.78 / 2.78 / 94.4	√
537	D	B	2.75 / 4.57 / 6.01 / 86.7	√	3.90 / 92.2 / 3.90	√
540	D	C	2.09 / 3.29 / 5.50 / 89.1	√	0.94 / 0.94 / 98.1	√
591	C	C	2.05 / 6.84 / 87.1 / 4.04	√	12.5 / 12.5 / 75.0	√
657	C	C	3.91 / 3.91 / 80.6 / 11.5	√	1.82 / 1.82 / 96.4	√
516	D	C	3.29 / 3.34 / 4.55 / 88.8	√	0.94 / 0.94 / 98.1	√
518	C	C	9.72 / 19.3 / 36.9 / 34.0	√	1.82 / 1.82 / 96.4	√
Accuracy			50/50=100%		48/50=96%	

Table S3: Theoretical test with incomplete data

No.	Actual test results	Predicted results %		
		Case 1	Case 2	Case 3
28	ORL: C	9.8 / 9.85 / 56.7 / 23.6√	13.2/ 13.2 / 50.1 / 23.5√	5.02 / 20.3 / 54.8 / 19.6√
	OHL: C	11.2 / 11.2 / 77.5 √	9.09 / 9.09 / 81.8 √	13.4 / 13.4 / 73.2 √
66	ORL: D	3.37 / 13.6 / 10. / 72.5 √	4.5 / 9.95 / 17.0 / 68.6 √	5.48 / 8.98 / 16.4 / 69.1 √
	OHL: C	25.5 / 25.5 / 48.9 √	25.0 / 25.0 / 50.0 √	11.6 / 11.6 / 76.8 √
79	ORL: B	14.7 / 58.5 / 14.6 / 12.1√	11.5 / 63.6 / 13.7 / 11.2√	6.81 / 48.7 / 22.0 / 22.5√
	OHL: C	20.1 / 20.1 / 58.9 √	12.5 / 12.5 / 75.0 √	13.7 / 13.7 / 72.6 √
82	ORL: B	2.61 / 78.1 / 10.2 / 9.07√	2.81 / 68.9 / 14.6 / 13.8√	6.4 / 54.8 / 19.8 / 19.0√

	OHL: B	7.03 / 78.4 / 16.4 ✓	3.9 / 92.2 / 3.9 ✓	6.07 / 76.4 / 17.5 ✓
88	ORL: D	3.97 / 9.29 / 8.14 / 78.6 ✓	3.88 / 7.97 / 11.2 / 76.9 ✓	4.19 / 6.63 / 11.5 / 77.6 ✓
	OHL: B	7.03 / 78.4 / 14.6 ✓	3.90 / 92.2 / 3.90 ✓	4.18 / 29.4 / 66.4 ✗
96	ORL: C	8.48 / 23.4 / 42.0 / 26.1 ✓	11.9 / 26.5 / 37.8 / 23.8 ✓	9.67 / 18.7 / 39.6 / 32.1 ✓
	OHL: B	12.5 / 74.9 / 12.5 ✓	1.92 / 96.2 / 1.92 ✓	8.70 / 34.1 / 57.2 ✗
98	ORL: D	7.39 / 11.3 / 10.7 / 70.5 ✓	8.10 / 15.6 / 13.8 / 62.5 ✓	8.84 / 11.2 / 12.0 / 58.0 ✓
	OHL: B	7.03 / 78.4 / 14.6 ✓	3.90 / 92.2 / 3.90 ✓	5.51 / 26.9 / 67.6 ✗
113	ORL: B	10.5 / 68.2 / 11.5 / 9.72 ✓	15.6 / 54.7 / 16.3 / 13.4 ✓	12.0 / 51.0 / 19.2 / 17.8 ✓
	OHL: B	27.2 / 45.6 / 27.2 ✓	20.0 / 60.0 / 20.0 ✓	38.2 / 41.6 / 20.2 ✓
123	ORL: D	6.46 / 9.23 / 17.0 / 67.3 ✓	6.09 / 11.6 / 21.8 / 60.5 ✓	5.01 / 7.84 / 15.0 / 72.2 ✓
	OHL: C	4.35 / 4.35 / 91.3 ✓	1.82 / 1.82 / 96.4 ✓	1.88 / 27.1 / 71.0 ✓
139	ORL: C	13.0 / 13.0 / 52.2 / 21.8 ✓	13.2 / 13.2 / 47.4 / 26.2 ✓	5.54 / 18.7 / 54.9 / 20.9 ✓
	OHL: B	12.5 / 74.9 / 12.5 ✓	1.92 / 96.2 / 1.92 ✓	5.41 / 66.7 / 27.9 ✓
144	ORL: C	3.81 / 7.18 / 78.6 / 10.4 ✓	5.05 / 10.5 / 67.6 / 16.8 ✓	5.01 / 8.45 / 69.9 / 16.6 ✓
	OHL: C	11.2 / 11.2 / 77.5 ✓	11.1 / 11.1 / 77.8 ✓	17.0 / 17.0 / 65.9 ✓
146	ORL: D	2.65 / 4.00 / 6.52 / 86.8 ✓	9.4 / 10.4 / 12.4 / 67.9 ✓	10.4 / 13.1 / 14.6 / 61.9 ✓
	OHL: C	4.35 / 4.35 / 91.3 ✓	1.82 / 1.82 / 96.4 ✓	2.03 / 19.5 / 78.5 ✓
154	ORL: D	3.14 / 4.23 / 6.45 / 86.2 ✓	4.15 / 7.59 / 13.9 / 74.4 ✓	4.31 / 6.74 / 12.8 / 76.1 ✓
	OHL: C	33.3 / 33.3 / 33.3 N / A	33.3 / 33.3 / 33.3 N / A	33.3 / 33.3 / 33.3 N / A
161	ORL: B	10.0 / 67.1 / 12.9 / 9.94 ✓	9.42 / 69.7 / 11.5 / 9.40 ✓	12.3 / 52.6 / 17.9 / 17.2 ✓
	OHL: B	5.62 / 74.4 / 20.0 ✓	1.59 / 95.2 / 3.17 ✓	2.21 / 82.3 / 15.5 ✓
168	ORL: D	4.22 / 12.2 / 10.2 / 73.3 ✓	3.88 / 7.97 / 11.2 / 76.9 ✓	4.64 / 7.33 / 13.8 / 74.2 ✓
	OHL: C	25.5 / 25.5 / 48.9 ✓	25.0 / 25.0 / 50.0 ✓	11.6 / 11.6 / 74.8 ✓
173	ORL: C	8.30 / 29.2 / 45.7 / 16.8 ✓	11.3 / 36.2 / 33.7 / 18.8 ✗	8.03 / 28.4 / 38.9 / 23.8 ✓
	OHL: A	19.7 / 66.0 / 14.4 ✗	88.9 / 5.56 / 5.56 ✓	31.9 / 45.3 / 22.8 ✗
205	ORL: B	9.14 / 57.6 / 19.2 / 14.0 ✓	11.8 / 38.5 / 28.2 / 21.5 ✓	15.9 / 35.0 / 27.1 / 22.0 ✓
	OHL: B	22.7 / 54.5 / 22.7 ✓	16.7 / 66.7 / 16.7 ✓	26.1 / 47.8 / 26.1 ✓
211	ORL: B	2.60 / 78.4 / 10.1 / 8.88 ✓	7.72 / 51.6 / 20.5 / 20.2 ✓	7.72 / 51.6 / 20.5 / 20.2 ✓
	OHL: B	7.03 / 78.4 / 14.6 ✓	7.18 / 70.2 / 22.6 ✓	7.18 / 70.2 / 22.6 ✓
213	ORL: B	15.1 / 50.6 / 22.5 / 11.9 ✓	16.8 / 49.0 / 23.2 / 11.1 ✓	29.1 / 35.0 / 20.6 / 15.3 ✓
	OHL: C	33.3 / 33.3 / 33.3 N / A	33.3 / 33.3 / 33.3 N / A	27.3 / 27.3 / 45.3 ✓
215	ORL: B	4.41 / 58.7 / 19.0 / 17.8 ✓	3.40 / 58.9 / 19.2 / 18.6 ✓	5.03 / 50.0 / 22.0 / 23.0 ✓
	OHL: B	5.62 / 74.4 / 20.0 ✓	1.59 / 95.2 / 3.17 ✓	2.21 / 82.3 / 15.5 ✓
228	ORL: B	5.06 / 60.7 / 17.7 / 16.6 ✓	3.37 / 59.4 / 18.9 / 19.3 ✓	11.8 / 32.2 / 22.2 / 33.7 ✗
	OHL: C	9.17 / 9.17 / 81.7 ✓	7.14 / 7.14 / 85.7 ✓	9.38 / 9.38 / 81.2 ✓
235	ORL: D	7.40 / 7.40 / 16.9 / 68.3 ✓	6.38 / 6.38 / 17.9 / 69.4 ✓	5.56 / 8.82 / 17.4 / 68.2 ✓
	OHL: C	18.7 / 18.7 / 62.6 ✓	11.1 / 11.1 / 77.8 ✓	8.7 / 34.1 / 57.2 ✓
247	ORL: C	2.78 / 14.8 / 74.8 / 7.5 ✓	2.59 / 18.3 / 67.8 / 11.4 ✓	4.86 / 15.2 / 68.4 / 11.5 ✓
	OHL: B	56.2 / 74.4 / 20.0 ✓	1.59 / 95.2 / 3.17 ✓	2.21 / 82.3 / 15.5 ✓
254	ORL: C	3.92 / 15.9 / 67.0 / 13.2 ✓	2.92 / 18.6 / 63.1 / 15.4 ✓	4.52 / 14.7 / 69.8 / 11.1 ✓
	OHL: B	7.03 / 78.4 / 14.6 ✓	3.90 / 92.2 / 3.90 ✓	6.07 / 76.4 / 17.5 ✓
260	ORL: D	7.93 / 7.93 / 19.8 / 64.3 ✓	5.59 / 5.59 / 17.2 / 71.1 ✓	3.82 / 5.94 / 13.3 / 77.0 ✓
	OHL: C	4.35 / 4.35 / 91.3 ✓	1.82 / 1.82 / 96.4 ✓	1.86 / 26.6 / 71.6 ✓
263	ORL: D	6.56 / 6.56 / 11.9 / 75.0 ✓	4.0 / 4.0 / 10.2 / 81.8 ✓	4.33 / 6.66 / 13.9 / 75.2 ✓

	OHL: C	4.35 / 4.35 / 91.3 ✓	3.57 / 3.57 / 92.9 ✓	5.84 / 11.4 / 82.8 ✓
277	ORL: D	4.67 / 4.92 / 6.20 / 84.2 ✓	7.21 / 7.33 / 7.44 / 77.0 ✓	6.32 / 6.68 / 7.67 / 79.3 ✓
	OHL: C	6.37 / 6.37 / 87.3 ✓	3.03 / 3.03 / 93.9 ✓	6.0 / 6.0 / 88.0 ✓
286	ORL: D	3.49 / 11.4 / 9.33 / 75.8 ✓	3.05 / 15.6 / 11.0 / 70.4 ✓	5.04 / 16.8 / 13.8 / 64.3 ✓
	OHL: B	5.62 / 74.4 / 20.0 ✓	1.59 / 95.2 / 3.17 ✓	2.21 / 82.3 / 15.5 ✓
299	ORL: D	3.31 / 4.64 / 7.04 / 85.0 ✓	3.16 / 5.54 / 9.91 / 81.4 ✓	3.24 / 4.80 / 8.6 / 83.4 ✓
	OHL: C	4.35 / 4.35 / 91.3 ✓	1.82 / 1.82 / 96.4 ✓	1.86 / 26.6 / 71.6 ✓
300	ORL: B	15.3 / 61.2 / 12. / 11.3 ✓	17.7 / 52.7 / 16.0 / 13.6 ✓	7.01 / 50.5 / 21.1 / 21.3 ✓
	OHL: A	36.4 / 31.8 / 31.8 ✓	81.8 / 9.09 / 9.09 ✓	31.0 / 46.6 / 22.5 ✗
323	ORL: D	6.46 / 9.23 / 17.0 / 67.3 ✓	4.16 / 7.71 / 16.9 / 71.2 ✓	4.43 / 6.66 / 13.9 / 75.2 ✓
	OHL: C	7.05 / 7.05 / 85.9 ✓	3.33 / 3.33 / 93.3 ✓	3.88 / 26.2 / 69.9 ✓
328	ORL: D	6.13 / 6.13 / 7.34 / 80.4 ✓	10.9 / 10.9 / 13.0 / 65.3 ✓	10.3 / 10.9 / 11.8 / 67.0 ✓
	OHL: C	4.35 / 4.35 / 91.3 ✓	3.57 / 3.57 / 92.9 ✓	4.75 / 6.76 / 88.5 ✓
340	ORL: D	4.9 / 18.7 / 17.4 / 59.0 ✓	3.58 / 24.8 / 17.0 / 54.6 ✓	4.68 / 15.0 / 12.2 / 68.1 ✓
	OHL: B	5.62 / 74.4 / 20.0 ✓	1.59 / 95.2 / 3.17 ✓	2.21 / 82.3 / 15.5 ✓
345	ORL: C	2.4 / 7.79 / 84.0 / 5.84 ✓	4.0 / 10.0 / 73.4 / 12.4 ✓	5.36 / 9.17 / 68.5 / 17.0 ✓
	OHL: B	5.62 / 74.4 / 20.0 ✓	1.59 / 95.2 / 3.17 ✓	1.92 / 30.7 / 67.7 ✗
452	ORL: B	4.45 / 73.3 / 12.2 / 10.1 ✓	3.21 / 68.1 / 14.9 / 13.8 ✓	5.45 / 59.0 / 17.8 / 17.8 ✓
	OHL: B	12.5 / 74.9 / 12.5 ✓	20.0 / 60.0 / 20.0 ✓	30.2 / 47.4 / 22.5 ✓
460	ORL: D	7.79 / 10.4 / 15.1 / 66.7 ✓	5.08 / 5.57 / 17.8 / 67.5 ✓	4.33 / 6.66 / 13.9 / 75.2 ✓
	OHL: C	4.35 / 4.35 / 91.3 ✓	1.82 / 1.82 / 96.4 ✓	1.86 / 26.6 / 71.6 ✓
466	ORL: D	8.77 / 16.0 / 15.2 / 60.0 ✓	7.56 / 11.1 / 11.7 / 69.5 ✓	7.12 / 7.52 / 8.60 / 76.8 ✓
	OHL: B	7.03 / 78.4 / 14.6 ✓	3.90 / 92.2 / 3.90 ✓	3.98 / 13.3 / 82.8 ✗
478	ORL: C	5.82 / 5.82 / 72.6 / 15.8 ✓	6.77 / 6.77 / 66.8 / 19.7 ✓	7.78 / 8.39 / 64.0 / 19.9 ✓
	OHL: C	7.05 / 7.05 / 85.9 ✓	3.33 / 3.33 / 93.3 ✓	3.88 / 26.2 / 69.9 ✓
482	ORL: D	7.77 / 8.24 / 9.54 / 74.5 ✓	9.57 / 9.72 / 10.6 / 70.1 ✓	10.5 / 11.1 / 12.2 / 66.3 ✓
	OHL: C	6.37 / 6.37 / 87.3 ✓	3.03 / 3.03 / 93.9 ✓	5.71 / 5.71 / 88.6 ✓
489	ORL: C	4.78 / 8.93 / 71.3 / 15.0 ✓	5.05 / 10.5 / 67.6 / 16.8 ✓	8.58 / 9.56 / 53.9 / 27.9 ✓
	OHL: C	4.35 / 4.35 / 91.3 ✓	1.82 / 1.82 / 96.4 ✓	1.86 / 26.6 / 71.6 ✓
493	ORL: D	4.98 / 5.43 / 6.93 / 82.7 ✓	6.77 / 6.89 / 8.00 / 78.3 ✓	6.67 / 7.03 / 8.00 / 78.3 ✓
	OHL: C	4.35 / 4.35 / 91.3 ✓	3.57 / 3.57 / 92.9 ✓	4.89 / 7.06 / 88.1 ✓
495	ORL: D	4.67 / 4.94 / 6.23 / 84.2 ✓	9.57 / 9.72 / 10.6 / 70.1 ✓	9.26 / 9.75 / 10.3 / 70.2 ✓
	OHL: C	11.2 / 11.2 / 77.5 ✓	11.1 / 11.1 / 77.8 ✓	13.6 / 13.6 / 72.7 ✓
507	ORL: B	2.15 / 83.9 / 7.99 / 6.00 ✓	2.81 / 68.9 / 14.6 / 13.8 ✓	5.19 / 57.1 / 18.7 / 19.0 ✓
	OHL: B	5.62 / 74.4 / 20.0 ✓	1.59 / 95.2 / 3.17 ✓	2.21 / 82.3 / 15.5 ✓
521	ORL: D	0.02 / 0.02 / 0.02 / 99.9 ✓	0.02 / 0.02 / 0.02 / 99.9 ✓	4.61 / 7.04 / 13.1 / 75.3 ✓
	OHL: C	4.91 / 4.91 / 90.2 ✓	2.78 / 2.78 / 94.4 ✓	4.56 / 4.56 / 90.9 ✓
537	ORL: D	3.41 / 10.1 / 8.49 / 78.0 ✓	3.67 / 7.34 / 10.2 / 78.8 ✓	5.02 / 9.1 / 15.2 / 70.6 ✓
	OHL: B	7.03 / 78.4 / 14.6 ✓	3.90 / 92.2 / 3.90 ✓	4.18 / 29.4 / 66.4 ✗
540	ORL: D	2.65 / 4.00 / 6.52 / 86.8 ✓	3.39 / 6.02 / 10.9 / 79.7 ✓	5.21 / 8.24 / 16.6 / 70.0 ✓
	OHL: C	4.17 / 4.17 / 91.7 ✓	0.94 / 0.94 / 98.1 ✓	3.38 / 3.38 / 93.2 ✓
591	ORL: C	2.40 / 7.79 / 84.0 / 5.84 ✓	2.85 / 17.8 / 66.4 / 13.0 ✓	5.45 / 17.0 / 65.1 / 12.4 ✓
	OHL: C	20.1 / 20.1 / 59.8 ✓	12.5 / 12.5 / 75.0 ✓	13.4 / 13.4 / 73.2 ✓
657	ORL: C	4.86 / 4.86 / 75.4 / 14.9 ✓	5.76 / 5.76 / 71.6 / 16.8 ✓	6.97 / 7.76 / 62.9 / 22.4 ✓

516	OHL: C	4.35 / 4.35 / 91.3 √	1.82 / 1.82 / 96.4 √	1.86 / 26.6 / 71.6 √
	ORL: D	4.05 / 4.21 / 5.54 / 86.3 √	5.37 / 5.47 / 6.6 / 82.6 √	8.37 / 8.89 / 9.93 / 72.8 √
	OHL: C	4.17 / 4.17 / 91.7 √	0.94 / 0.94 / 98.1 √	2.54 / 2.54 / 94.9 √
518	ORL: C	15.4 / 28.6 / 31.3 / 24.7√	13.3 / 26.5 / 34.9 / 25.2√	13.3 / 24.5 / 35.4 / 26.8√
	OHL: C	4.35 / 4.35 / 91.3 √	1.82 / 1.82 / 96.4 √	1.88 / 27.1 / 71.0 √
Accuracy		ORL:49/50=98%	ORL:49/50=98%	ORL:49/50=98%
		OHL:48/50=96%	OHL:48/50=96%	OHL:41/50=82%

Notes: OSL: Overall safety level; OHL: Overall habitability level

Table S4: Practical test

NO.	Actual test results		Classification results %	
	OSL (A/B/C/D)	OHL (A/B/C)	OSL (A/B/C/D)	OHL (A/B/C)
8	D	C	6.06/11.6/21.6/ 60.7 √	11.1/11.1/77.8√
45	D	C	2.63/4.43/7.74/ 85.2 √	11.7/11.7/76.6√
37	C	C	1.97/4.45/ 88.1 /5.43√	11.1/11.1/77.8√
51	C	C	1.88/4.48/ 88.5 /5.18√	9.09/9.09/ 81.8 √
28	D	C	4.09/7.46/13.4/ 75.1 √	0.94/0.94/ 98.1 √
49	D	C	4.43/8.21/15.2/ 72.2 √	2.78/2.78/ 94.4 √
148	C	C	4.32/10.7/ 71.7 /13.3√	8.33/8.33/ 83.3 √
254	C	C	3.25/13.6/ 71.2 /12.0√	3.57/3.57/ 92.9 √
187	D	C	5.37/5.37/14.6/ 74.7 √	0.94/0.94/ 98.1 √
11	B	B	2.31/77.0/10.8/9.88√	1.59/ 95.2 /3.17√
18	C	B	2.74/7.22/ 83.8 /6.27√	3.90/ 92.2 /3.90√
168	D	C	4.67/4.67/9.13/ 81.5 √	11.1/33.3/ 55.6 √
247	B	C	2.09/13.1/ 80.1 /4.7 ×	25.0/25.0/ 50.0 √
369	C	B	3.95/33.4/ 40.5 /22.1√	1.59/ 95.2 /3.17√
482	B	B	2.09/13.1/ 80.1 /4.7 ×	1.59/ 95.2 /3.17√
604	D	C	0.02/0.02/0.02/ 99.9 √	3.03/3.03/ 93.9 √
554	B	B	2.31/77.0/10.8/9.88√	1.59/ 95.2 /3.17√
352	B	C	3.72/ 72.6 /12.2/11.5√	2.78/2.78/ 94.4 √
88	B	C	2.31/77.0/10.8/9.88√	25.0/25.0/ 50.0 √
145	B	B	2.31/77.0/10.8/9.88√	1.59/ 95.2 /3.17√
167	C	B	2.41/11.9/ 78.2 /7.47√	9.09/9.09/ 81.8 ×
258	B	B	2.31/77.0/10.8/9.88√	11.1/33.3/ 55.6 ×
246	B	C	2.31/77.0/10.8/9.88√	14.3/14.3/ 71.4 √
278	C	B	3.02/7.02/ 83.4 /6.57√	1.59/ 95.2 /3.17√
452	B	B	2.31/77.0/10.8/9.88√	1.59/ 95.2 /3.17√
6	B	B	2.31/77.0/10.8/9.88√	1.59/ 95.2 /3.17√
547	C	C	3.09/6.97/ 80.8 /9.15√	1.59/ 95.2 /3.17 ×

562	B	B	2.31/77.0/10.8/9.88 ✓	1.59/95.2/3.17 ✓
125	B	B	3.72/72.6/12.2/11.5 ✓	33.3/33.3/33.3 N/A
264	C	C	20.9/13.1/80.1/4.7 ✓	14.3/14.3/71.4 ✓
358	C	C	13.9/13.9/57.7/14.5 ✓	2.78/2.78/94.4 ✓
211	C	B	2.72/19.8/64.6/12.9 ✓	1.59/95.2/3.17 ✓
78	C	B	18.7/23.4/37.5/20.5 ✓	1.59/95.2/3.17 ✓
123	B	C	3.09/6.71/83.1/7.09 ✗	1.82/1.82/96.4 ✓
48	C	C	2.72/19.8/64.6/12.9 ✓	11.1/33.3/55.6 ✓
69	D	C	3.37/5.98/10.8/79.9 ✓	1.82/1.82/96.4 ✓
408	C	B	8.60/8.60/61.9/20.9 ✓	1.59/95.2/3.17 ✓
268	C	C	4.38/7.10/78.6/9.92 ✓	2.78/2.78/94.4 ✓
44	C	B	2.72/19.8/64.4/12.9 ✓	3.90/92.2/3.90 ✓
152	C	C	9.72/9.72/52.7/27.9 ✓	1.82/1.82/96.4 ✓
296	B	B	2.31/77.0/10.8/9.88 ✓	1.59/95.2/3.17 ✓
300	D	C	4.29/4.29/11.1/80.3 ✓	2.78/2.78/94.4 ✓
78	C	B	3.05/7.15/81.8/8.04 ✓	1.59/95.2/3.17 ✓
108	C	C	2.41/11.9/78.2/7.47 ✓	7.14/7.14/85.7 ✓
107	B	C	2.31/77.0/10.8/9.88 ✓	9.09/9.09/81.8 ✓
33	D	C	3.37/5.98/10.8/79.9 ✓	0.94/0.94/98.1 ✓
58	D	C	4.17/7.61/13.9/74.3 ✓	2.78/2.78/94.4 ✓
214	D	C	4.28/4.50/5.57/85.6 ✓	3.03/3.03/93.9 ✓
289	D	C	0.02/0.02/0.02/99.9 ✓	3.03/3.03/93.9 ✓
547	C	B	14.9/14.9/41.7/28.5 ✓	1.59/95.2/3.17 ✓
Accuracy			47/50=94%	46/50=92%

Notes: OSL: Overall safety level; OHL: Overall habitability level