Transitional shelter wind load analysis

Lessons learned

IASC Inter-Agency Standing Committee
HAITI SHELTER CLUSTER

UNOPS

Analysis method

- Structures tested with a Category 1 wind load (108mph)

TABLE C6-2 APPROXIMATE RELATIONSHIP BETWEEN WIND SPEEDS IN ASCE 7 AND SAFFIR/SIMPSON HURRICANE SCALE

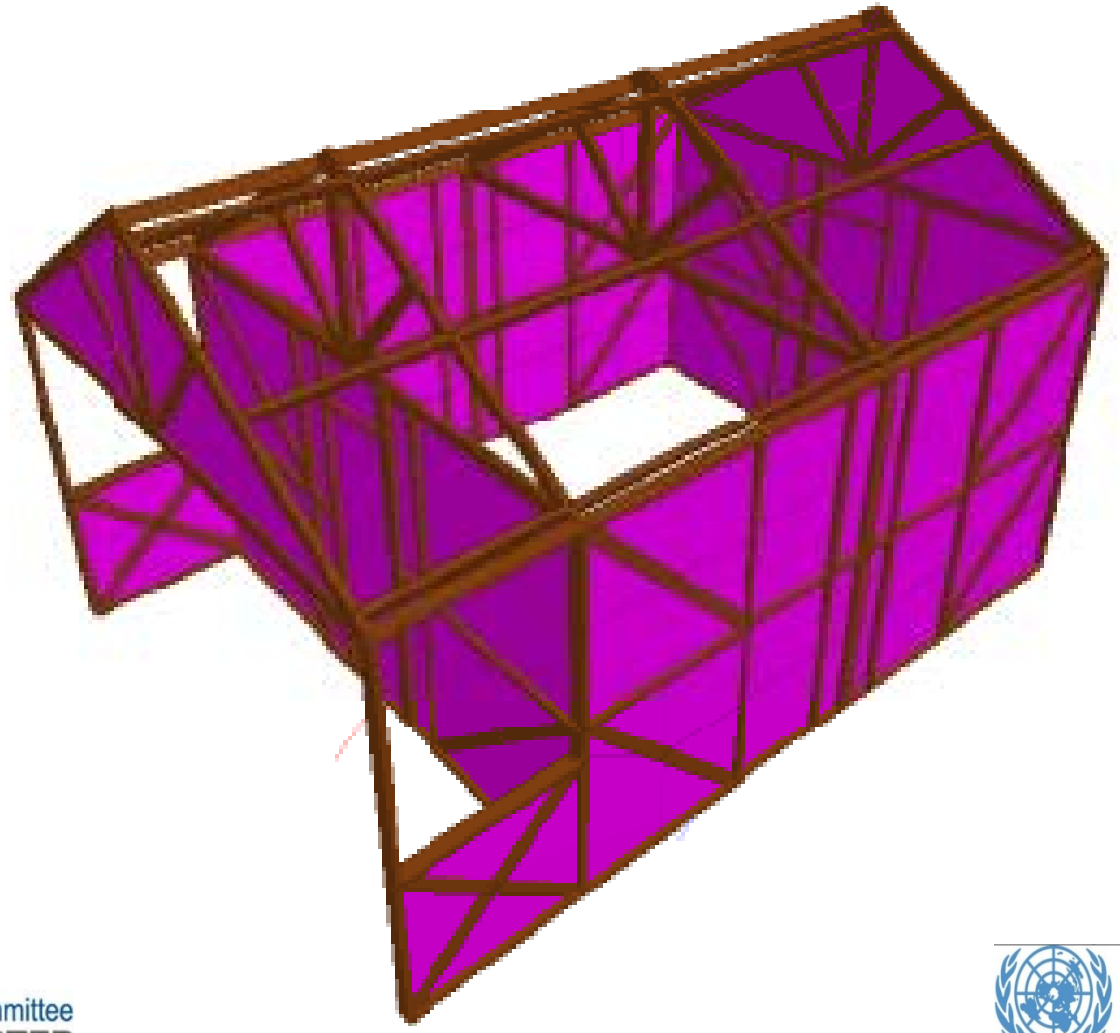
Saffir/Simpson Hurricane Category	Sustained Wind Speed Over Water[a]		Gust Wind Speed Over Water[b]		Gust Wind Speed Over Land[c]	
	mph	(m/s)	mph	(m/s)	mph	(m/s)
1	74–95	33.1–42.5	91–116	40.7–51.9	82–108	36.7–48.3
2	96–110	42.6–49.2	117–140	52.0–62.6	109–130	48.4–58.1
3	111–130	49.3–58.1	141–165	62.7–73.8	131–156	58.2–69.7
4	131–155	58.2–69.3	166–195	73.9–87.2	157–191	69.8–85.4
5	> 155	> 69.3	> 195	> 87.2	> 191	> 85.4

[a] 1-minute average wind speed at 33 ft (10 m) above open water

[b] 3-second gust wind speed at 33 ft (10 m) above open water

[c] 3-second gust wind speed at 33 ft (10 m) above open ground in Exposure Category C. This column has the same basis (averaging time, height, and exposure) as the basic wind speed from Fig. 6-1.

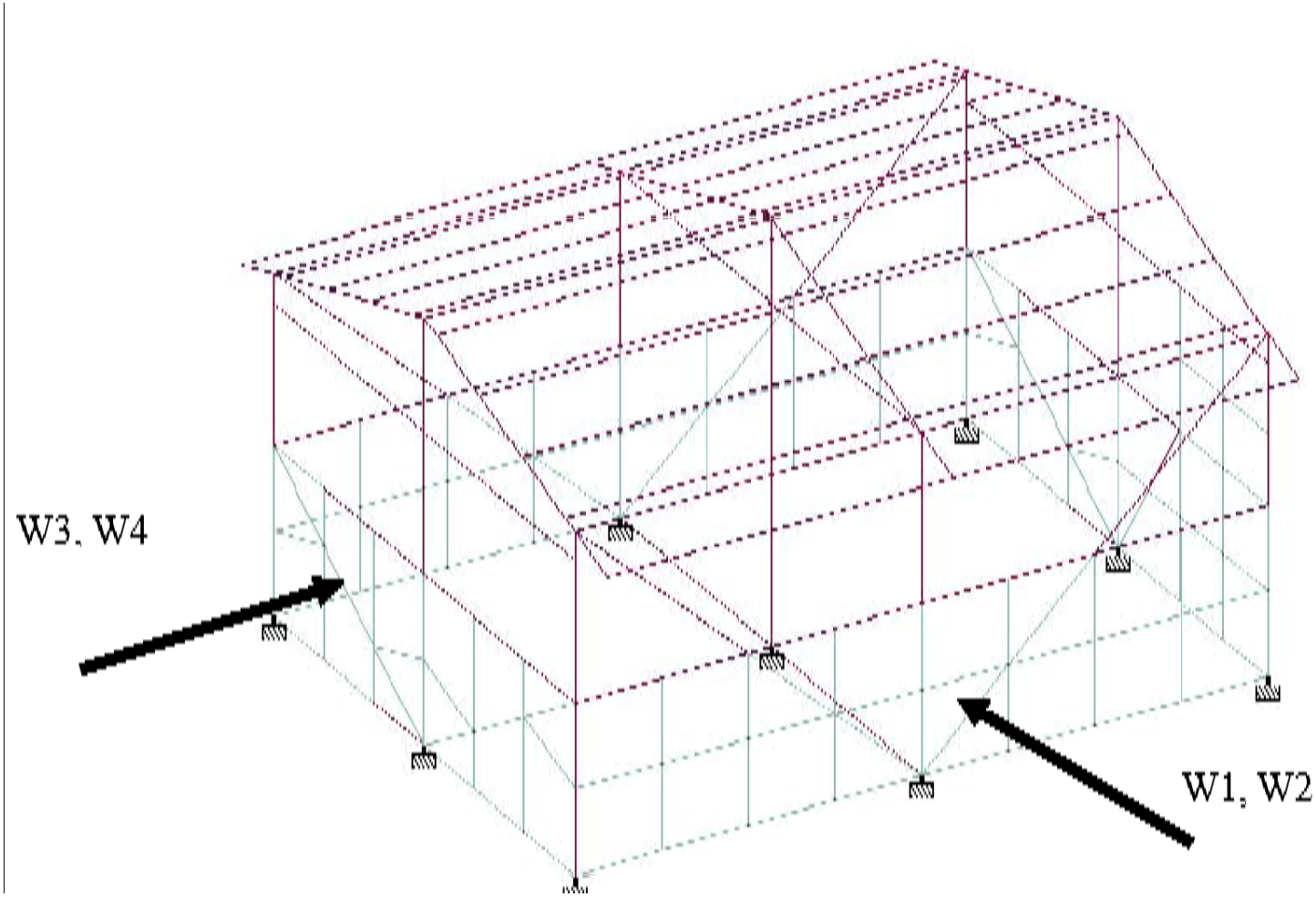
- Based on the supplied drawings, the structure was modeled in the analysis software



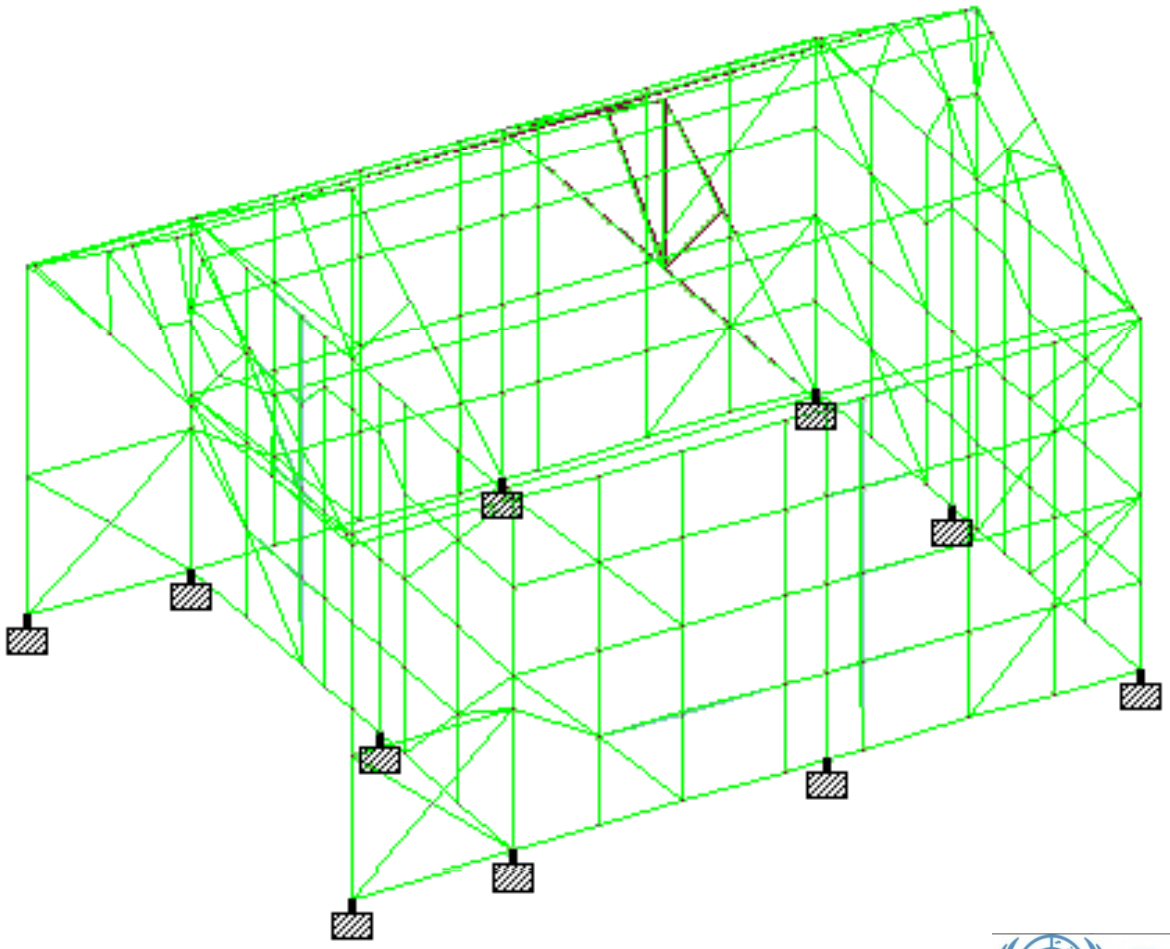
IASC Inter-Agency Standing Committee
HAITI SHELTER CLUSTER

UNOPS

- The wind forces were added to the model of the structure



- The structure was analyzed to identify weak points in the structure



IASC Inter-Agency Standing Committee
HAITI SHELTER CLUSTER

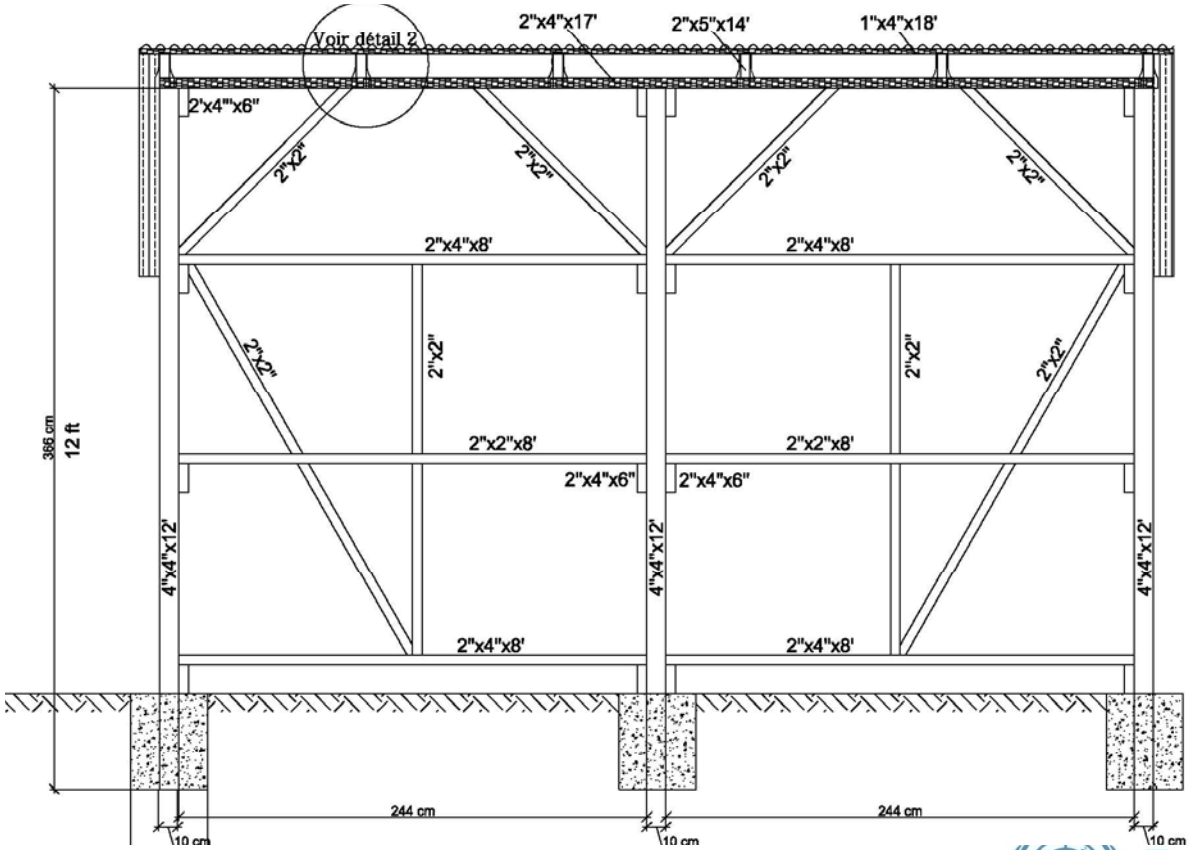
UNOPS

General results will focus on the three areas of the structure

- Wall Design
- Roof Design
- Foundation Design

Wall Design

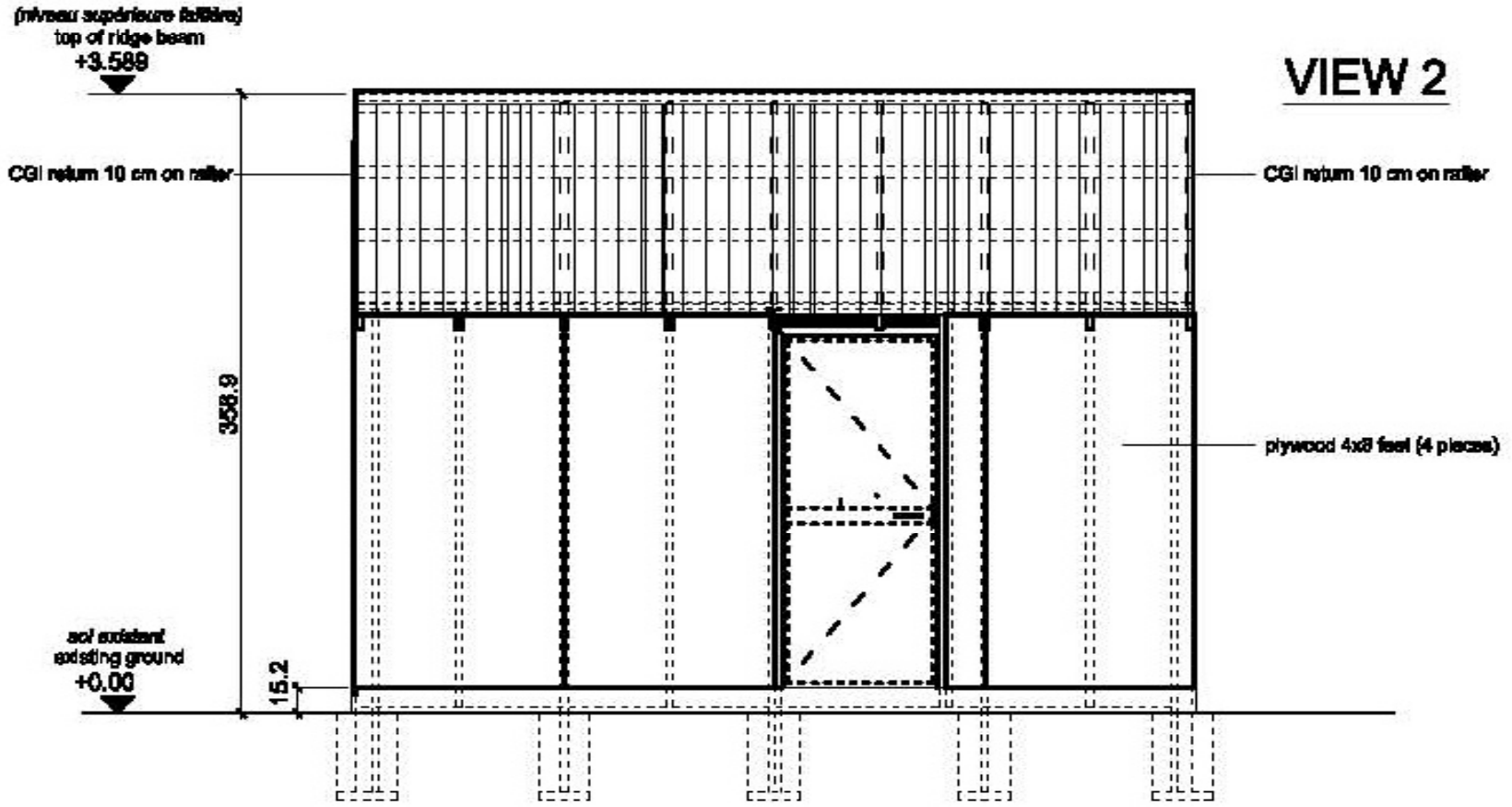
- Wall construction should be completed with 4x4 posts and 2x4 members generally preformed well in the test.
- Construction with 1x4 and 2x2 members generally did not perform well



IASC Inter-Agency Standing Committee
HAITI SHELTER CLUSTER

UNOPS

- Plywood increases the strength and rigidity of the structure



IASC Inter-Agency Standing Committee
HAITI SHELTER CLUSTER

UNOPS

Roof Design

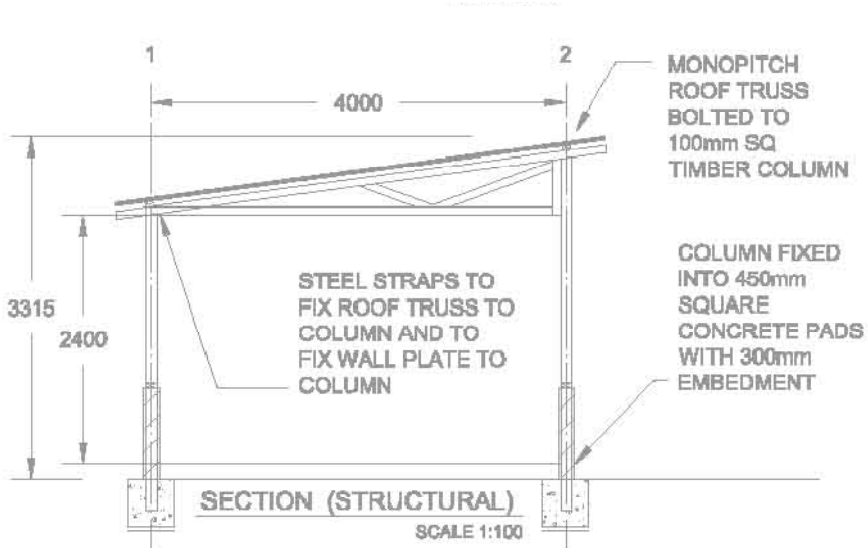
- 30^{o} roof angle is preferable to lower sloped, or monosloped roofs

	30 to 45	1	19.6	13.5	15.7	10.8	1.5	-11.9	0.6	-10.3	-6.9	-7.9
		2	19.6	13.5	15.7	10.8	7.6	-5.8	6.5	-4.2	-6.9	-7.9
110	0 to 5°	1	19.2	-10.0	12.7	-5.9	-23.1	-13.1	-16.0	-10.1	-32.3	-25.3
	10°	1	21.6	-9.0	14.4	-5.2	-23.1	-14.1	-16.0	-10.8	-32.3	-25.3
	15°	1	24.1	-8.0	16.0	-4.6	-23.1	-15.1	-16.0	-11.5	-32.3	-25.3
	20°	1	26.6	-7.0	17.7	-3.9	-23.1	-16.0	-16.0	-12.2	-32.3	-25.3
	25°	1	24.1	3.9	17.4	4.0	-10.7	-14.6	-7.7	-11.7	-19.9	-17.0
		2	-------	-------	-------	-------	-4.1	-7.9	-1.1	-5.1	-------	-------
	30 to 45	1	21.6	14.8	17.2	11.8	1.7	-13.1	0.6	-11.3	-7.6	-8.7
		2	21.6	14.8	17.2	11.8	8.3	-6.5	7.2	-4.6	-7.6	-8.7
	0 to 5°	1	22.8	-11.9	15.1	-7.0	-27.4	-15.6	-19.1	-12.1	-38.4	-30.1
	10°	1	25.8	-10.7	17.1	-6.2	-27.4	-16.8	-19.1	-12.9	-38.4	-30.1

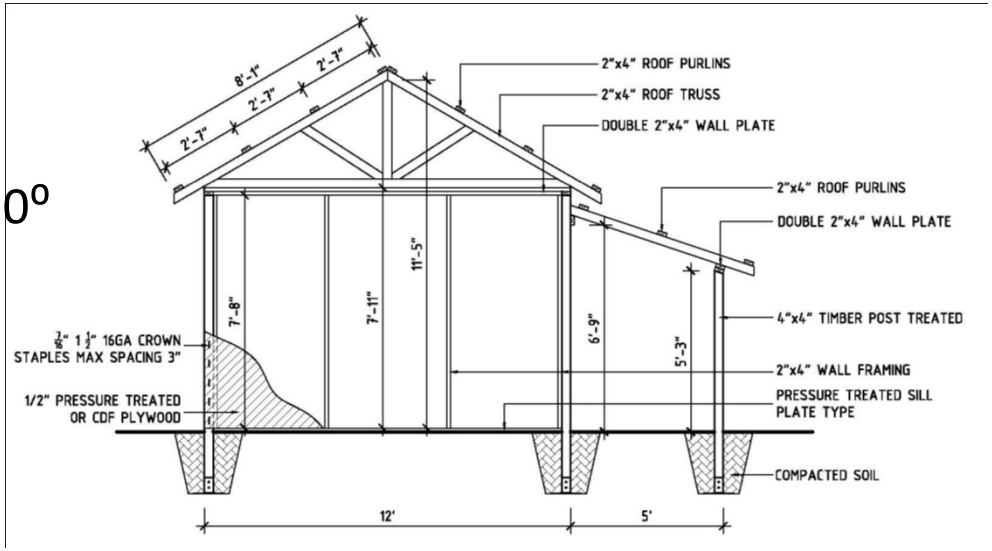
IASC Inter-Agency Standing Committee
HAITI SHELTER CLUSTER

UNOPS

Roof Slope= 13º



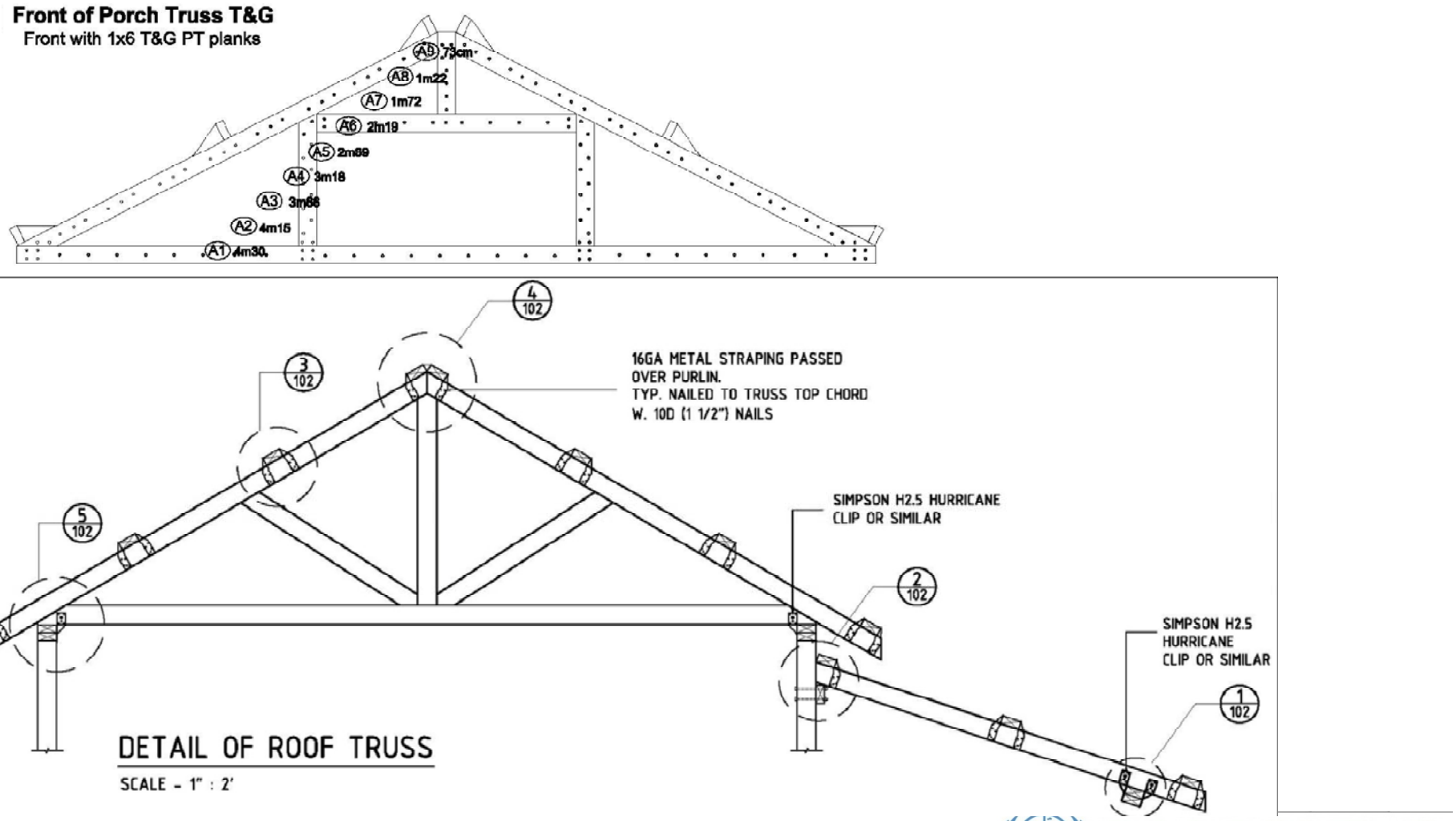
Roof Slope= 30º



IASC Inter-Agency Standing Committee
HAITI SHELTER CLUSTER

UNOPS

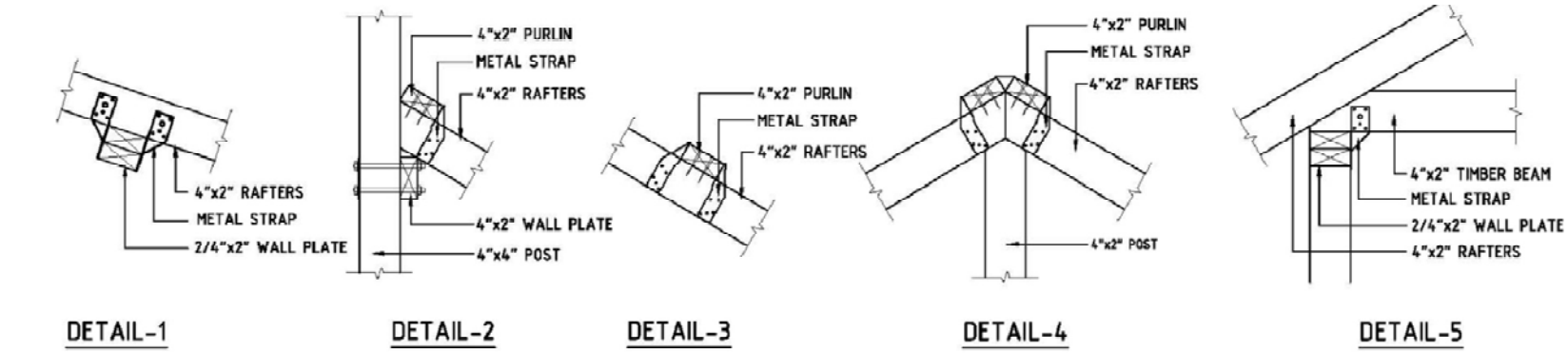
- Purlins must be of adequate size and quantity



IASC Inter-Agency Standing Committee
HAITI SHELTER CLUSTER

UNOPS

- Steel straps for roof connections

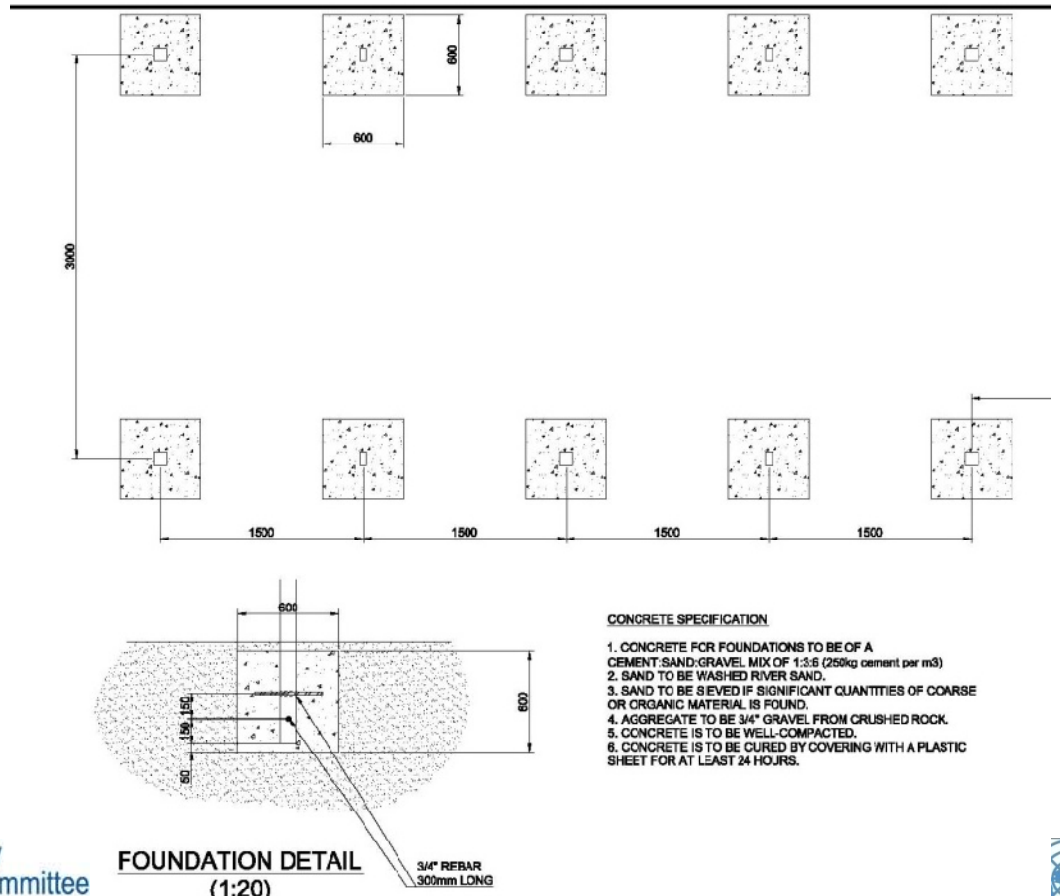


IASC Inter-Agency Standing Committee
HAITI SHELTER CLUSTER

UNOPS

Foundation

- Typical foundation design includes blocks of concrete to anchor the posts into the ground
- It is important to ensure these blocks are large enough

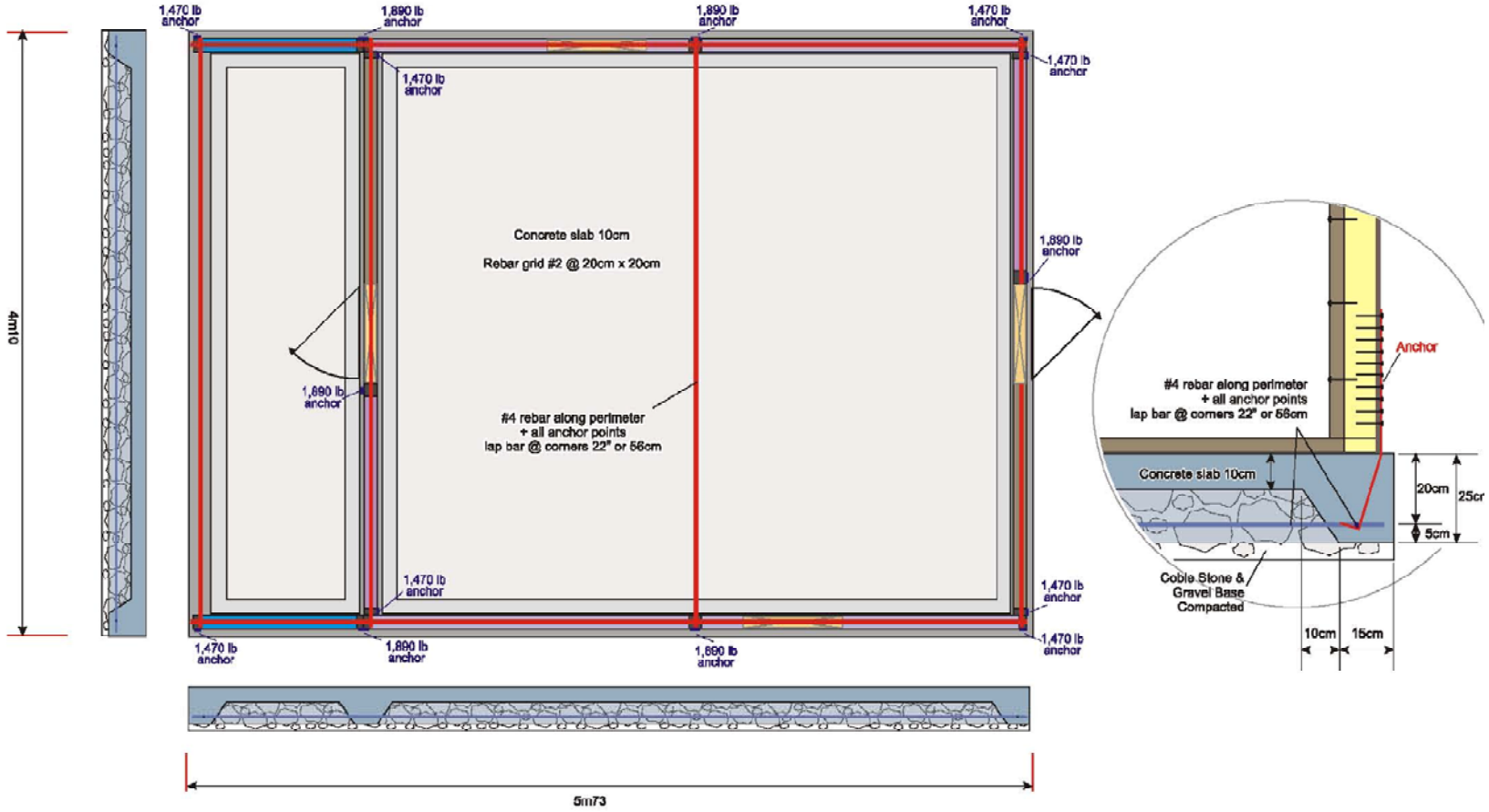


FOUNDATION DETAIL
(1:20)

IASC Inter-Agency Standing Committee
HAITI SHELTER CLUSTER

UNOPS

- Some alternatives include using a reinforced concrete beam and slab, earth anchors, or using deeper foundations.



IASC Inter-Agency Standing Committee
HAITI SHELTER CLUSTER

UNOPS

Conclusions

- The wind forces applied to the structure cause large stresses in the structure.
- Walls must have adequate strength and rigidity to resist a direct wind force.
- Roof and foundation designs are governed by uplift forces.

Any Questions?

IASC Inter-Agency Standing Committee
HAITI SHELTER CLUSTER

UNOPS