Wind-resitence Analysis Report

Sample Name: MG9 Outdoor LED Screen with ground stacking structure

& hanging structure

Client: HUNAN YESTECH OPTOELECTRONIC CO., LTD.

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I. Brief Introduction

This report analysis the loading distribution solution for 3 different options with ground stacking structure and 1 size with hanging structure under different wind levels.

II. Option 1: Screen size: 8 panels high x 15 panels wide, Ground Stacking Structure;

1. The total weight of Option 1 LED screen is about 1580kgs, and the main size of the screen structure is about 1.09*7.3*4.138 m (dimensions in order of the finite element model X/Y/Z direction).

The structural analysis considers the following base loads.

a) Self-weight of the structure;

b) Beaufort scale - 4 Level (standard wind pressure 40.3 Pa, considering three times safety factor, design wind pressure 121 Pa);

c) Beaufort scale - 6 Level(standard wind pressure 122.8 Pa, considering three times safety factor, design wind pressure 369 Pa);

d) Beaufort scale - 8 Level(standard wind pressure 276.4 Pa, design wind pressure 830 Pa considering triple safety factor).

2. Loading distribution under Beaufort scale- 4 Level

Under the 4-level wind design load, if the wind direction is X-axis positive, that is the back of the LED screen structure is subject to wind load, the moment value of the screen's self-weight on the front foot is 6988 N*m, which is smaller than the moment of the wind load on the ground of 7145.0 N*m. and it is considered that LED screen is at a risk of overturning. It is necessary to place a weight at the rear of the screen structure. The mass of the weight ‘M’ is calculated according to the following formula:

(M+1580)*1.09/2=1580*(1.09-0.64)+M*1.09

M=254.42 kg

According to the calculation, the mass of the load at the rear of the screen is 254.42 kg, as shown in Figure 6-2-1.

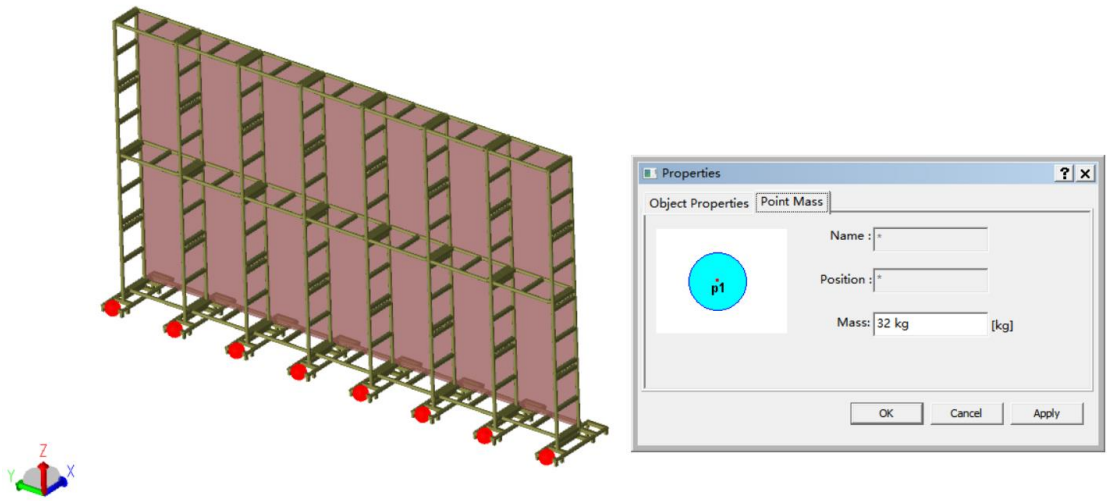


Figure 6-2-1 4-Level wind design load distribution (32kg*8)

At this time, the total weight of the LED screen is 1836kg (including the load mass), the centre of gravity is 0.536m from the front feet and 0.554m from the rear feet. The minimum tilting moment of the weight is 9651 N*m, which is greater than that of the tilting moment of the 4-level wind design load on the ground (7145 N*m).

In summary, under the design load of 4-level wind, it is necessary to add 32kg counterweight(single) at the rear of the LED

screen, and configure 8 counterweights, with a total of 256 kg counterweights.

2. Loading distribution under Beaufort scale- 6 Level

Under the 6-level wind design load, the LED screen is at a risk of overturning regardless whether the wind direction towards the X-axis is positive or negative. It is necessary to place a weight at the rear of the screen structure. The mass of the weight 'M_min.' is calculated according to the following formula:

M_min*9.80665*1.09/2=21789.4

M_min=4076.9 kg

Therefore, the mass of the weight 'M' is calculated according to the following formula:

M=M_min-1580=2496.9 kg

The centre-of-gravity position of the weight is calculated according to the following formula:

1580*0.45+2496.9*(1.09-X)=4076.9*1.09/2

X=0.4849 m

According to the calculation, the mass of the load at the rear of the screen is 2496.9 kg, as shown in Figure 6-4-1.

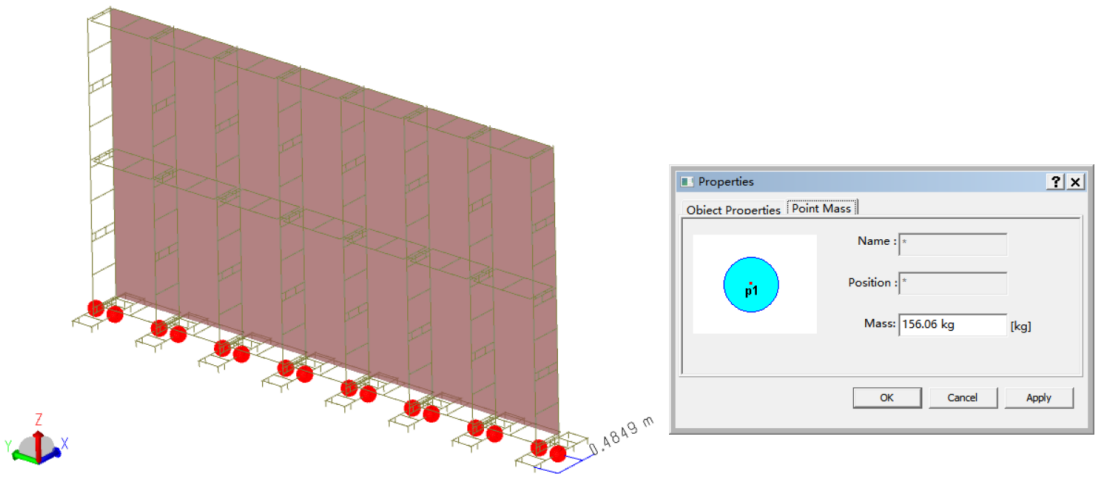


Figure 6-4-1 6-Level wind design load distribution (156.06kg*16)

At this time, the total weight of the LED screen is 4076.9 kg (including the load mass), the centre of gravity is 0.545m from the front feet and 0.545m from the rear feet, and the minimum tilting moment of the weight is 21789.5 N*m, which is equal to the tilting moment of the 6-level wind design load on the ground (21789.4 N*m).

In summary, under the design load of 6-level wind, it is necessary to add 156.06 kg of counterweight (single) at the rear of the LED screen, and configure 16 counterweights, with a total of 2496.9 kg counterweight.

4. Loading distribution under Beaufort scale- 8 Level

Under the 8-level wind design load, the LED screen is at a risk of overturning regardless whether the wind direction towards the X-axis is positive or negative. It is necessary to load heavy objects at the rear of the screen structure. The mass of the weight 'M_min.' is calculated according to the following formula:

M_min*9.80665*1.09/2=49011.4

M_min=9170.23 kg

Therefore, the mass of the weight 'M' is calculated according to the following formula:

M=M_min-1580=7590.23 kg

The centre-of-gravity position of the weight is calculated according to the following formula:

1580*0.45+7590.23*（1.09-X）=9170*1.09/2

X=0.5252 m

According to the calculation, the mass of the load at the rear of the screen is 7590.23kg, as shown in Figure 6-6-1.

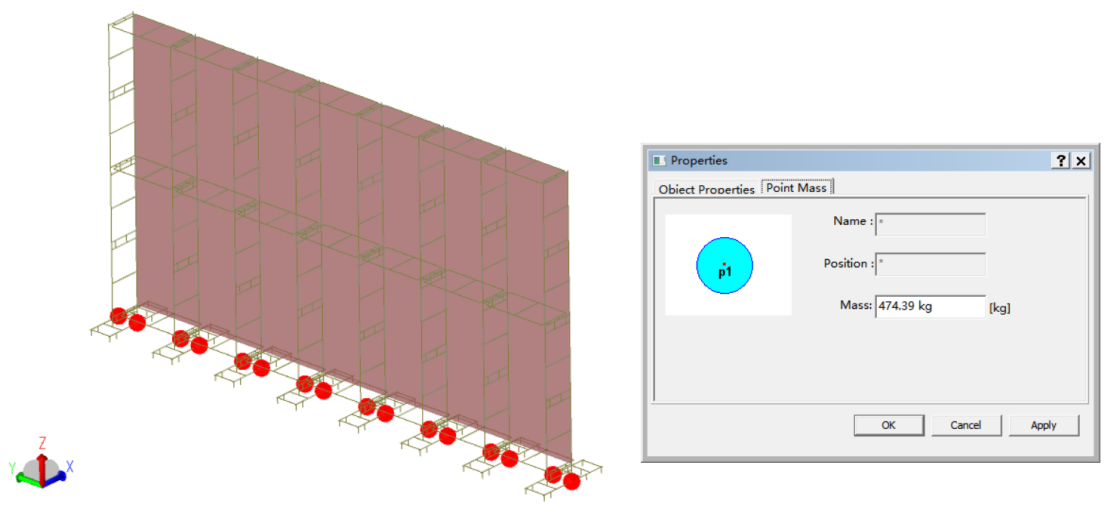


Figure 6-6-1 8-Level wind design load distribution (474.39kg*16)

At this time, the total weight of the LED screen is 9170.23 kg (including the load mass), the center of gravity is 0.545m from the front feet, and 0.545m from the rear feet. The minimum weight anti-overturning moment is 49011.4 N*m, which is equal to the tilting moment of the 8-level wind design load on the ground (49011.4 N*m).

In summary, under the design load of 8-level wind, it is necessary to add 474.39 kg counterweight (single) at the rear of the LED screen, and configure 16 counterweights, with a total of 7590.23kg counterweights.

5. **In conclusion**

According to the above analysis results, the loading distribution of the LED screen under different wind levels is as shown in Table 7-1-1.

Table 7-1-1 LED Screen loading distribution

Installation Structure	Screen Size	Beaufort scale	Loading mass (kg)	Weight Quantity (pc)	Weight Location
Ground stacking	8 panels high x 15 panels wide (4m/13.1' H x 7.5m/24.6'W)	4-level wind design load	32	8	at the rear feet of the LED screen
		6-level wind design load	156.1	16	about 0.485m from the rear feet of the LED screen
		8-level wind design load	474.4	16	about 0.525m from the rear feet of the LED screen

III. Option 2: Screen size: 10 panels high x 20 panels wide, Ground Stacking Structure;

1. The total weight of Option 2 LED screen is about 2743kgs, and the main size of the screen structure is about 1.09*10.3*5.138 m (dimensions in order of the finite element model X/Y/Z direction).

The structural analysis considers the following base loads.

a) Self-weight of the structure;

b) Beaufort scale - 4 Level (standard wind pressure 40.3 Pa, considering three times safety factor, design wind pressure 121 Pa);

c) Beaufort scale - 6 Level(standard wind pressure 122.8 Pa, considering three times safety factor, design wind pressure 369 Pa);

d) Beaufort scale - 8 Level(standard wind pressure 276.4 Pa, design wind pressure 830 Pa considering triple safety factor).

2. Loading distribution under Beaufort scale- 4 Level

Under the 4-level wind design load, if the wind direction is X-axis positive, that is the back of the LED screen structure is subject to wind load, the moment value of the screen's self-weight on the front foot is 12050.7N*m, which is smaller than the moment of the wind load on the ground of 15944 N*m. and it is considered that LED screen is at a risk of overturning. It is necessary to place a weight at the rear of the screen structure. The mass of the weight ‘M’ is calculated according to the following formula:

（M+2742.86）*1.09/2=2742.86*（1.09-0.642）+M*1.09

M=488.18 kg

According to the calculation, the mass of the load at the rear of the screen is 488.18 kg, as shown in Figure 6-2-2.

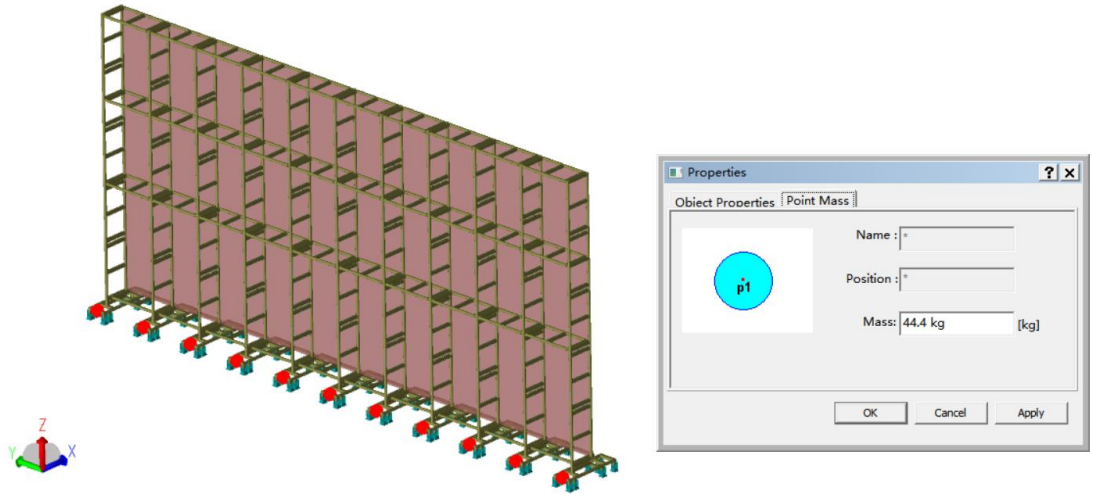


Figure 6-2-2 4-Level wind design load distribution (44.4kg*11)

At this time, the total weight of the LED screen is 3232kg (including the load mass), the centre of gravity is 0.545m from the front feet and 0.545m from the rear feet. The minimum tilting moment of the weight is 17269.9 N*m, which is greater than that of the tilting moment of the 4-level wind design load on the ground (15944 N*m).

In summary, under the design load of 4-level wind, it is necessary to add 44.4kg counterweight(single) at the rear of the LED screen, and configure 11 counterweights, with a total of 448.18 kg counterweights.

3. Loading distribution under Beaufort scale- 6 Level

Under the 6-level wind design load, the LED screen is at a risk of overturning regardless whether the wind direction towards the X-axis is positive or negative. It is necessary to place a weight at the rear of the screen structure. The mass of the weight ‘M_min.’ is calculated according to the following formula:

M_min*9.80665*1.09/2=48622.5

M_min=9097.46 kg

Therefore, the mass of the weight ‘M’ is calculated according to the following formula:

M=M_min-2742.86=6354.6 kg

The centre-of-gravity position of the weight is calculated according to the following formula:

2742.86*0.488+6354.6*（1.09-X）=9097.46*1.09/2

X=0.5204 m

According to the calculation, the mass of the load at the rear of the screen is 6354.6 kg, as shown in Figure 6-4-2.

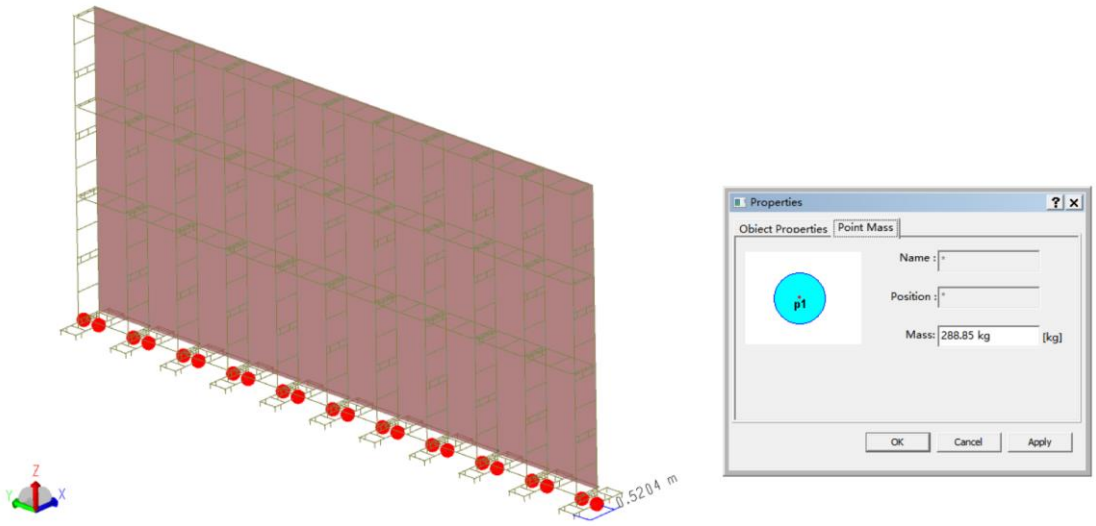


Figure 6-4-2 6-Level wind design load distribution (288.85kg*22)

At this time, the total weight of the LED screen is 9097.46 kg (including the load mass), the centre of gravity is 0.545m from the front feet and 0.545m from the rear feet, and the minimum tilting moment of the weight is 48622.5 N*m, which is equal to the tilting moment of the 6-level wind design load on the ground (48622.5 N*m).

In summary, under the design load of 6-level wind, it is necessary to add 288.85 kg of counterweight (single) at the rear of the LED screen, and configure 22 counterweights, with a total of 6354.6 kg counterweight.

4. Loading distribution under Beaufort scale- 8 Level

Under the 8-level wind design load, the LED screen is at a risk of overturning regardless whether the wind direction towards the X-axis is positive or negative. It is necessary to load heavy objects at the rear of the screen structure. The mass of the weight 'M_min.' is calculated according to the following formula:

M_min*9.80665*1.09/2=109368
M_min=20463.18 kg

Therefore, the mass of the weight 'M' is calculated according to the following formula:
M=M_min-2742.86=17720.32 kg

The centre-of-gravity position of the weight is calculated according to the following formula:

2472.86*0.448+17720.32*（1.09-X）=20463.18*1.09/2

X=0.5232 m

According to the calculation, the mass of the load at the rear of the screen is 17720.32 kg, as shown in Figure 6-6-2.

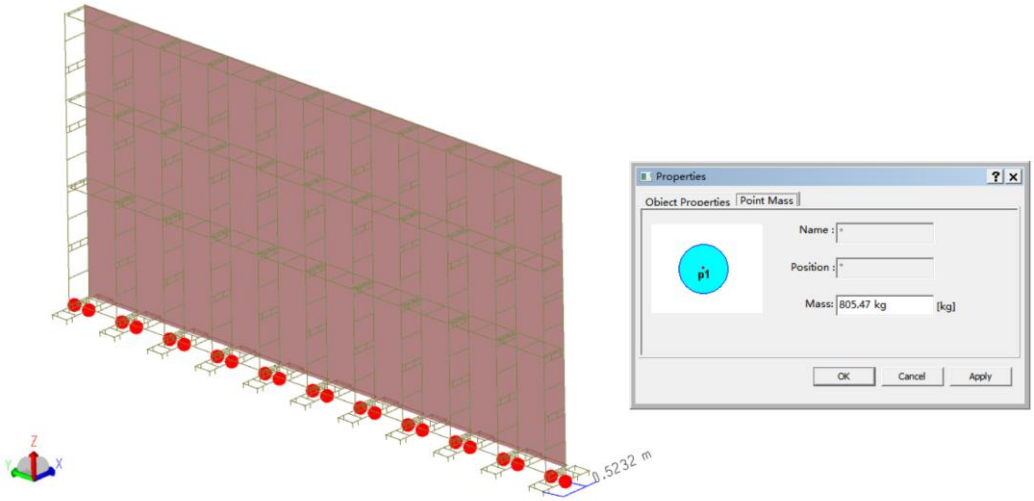


Figure 6-6-2 6-Level wind design load distribution (805.47 kg*22)

At this time, the total weight of the LED screen is 20463.18 kg (including the load mass), the center of gravity is 0.545m from the front feet, and 0.545m from the rear feet. The minimum weight anti-overturning moment is 109368 N*m, which is equal to the tilting moment of the 8-level wind design load on the ground (109368 N*m).

In summary, under the design load of 8-level wind, it is necessary to add 805.47 kg counterweight (single) at the rear of the LED screen, and configure 22 counterweights, with a total of 7590.23kg counterweights.

5. **In conclusion**

According to the above analysis results, the loading distribution of the LED screen under different wind levels is as shown in Table 7-1-2.

Table 7-1-2 LED Screen loading distribution

Installation Structure	Screen Size	Beaufort scale	Loading mass (kg)	Weight Quantity (pc)	Weight Location
Ground stacking	10 panels high x 20 panels wide (5m/16.4 H x 10m/32.8'W)	4-level wind design load	44.4	11	at the rear feet of the LED screen
		6-level wind design load	288.85	22	about 0.52m from the rear feet of the LED screen
		8-level wind design load	805.47	22	about 0.523m from the rear feet of the LED screen

IV. Option 3: Screen size: 12 panels high x 24 panels wide, Ground Stacking Structure;

1. The total weight of Option 3 LED screen is about 3881kgs, and the main size of the screen structure is about 1.09*12.3*6.138 m (dimensions in order of the finite element model X/Y/Z direction).

The structural analysis considers the following base loads.

a) Self-weight of the structure;

b) Beaufort scale - 4 Level (standard wind pressure 40.3 Pa, considering three times safety factor, design wind pressure 121 Pa);
c) Beaufort scale - 6 Level(standard wind pressure 122.8 Pa, considering three times safety factor, design wind pressure 369 Pa);
d) Beaufort scale - 8 Level(standard wind pressure 276.4 Pa, design wind pressure 830 Pa considering triple safety factor).

2. Loading distribution under Beaufort scale- 4 Level

Under the 4-level wind design load, the LED screen is at a risk of overturning regardless whether the wind direction towards the X-axis is positive or negative. It is necessary to place a weight at the rear of the screen structure. The mass of the weight 'M_min.' is calculated according to the following formula:

M_min*9.80665*1.09/2=27319.1

M_min=5111.51 kg

Therefore, the mass of the weight 'M' is calculated according to the following formula:

M=M_min-3880.9=1230.61 kg

The centre-of-gravity position of the weight is calculated according to the following formula:

3880.9*0.488+1230.61*（1.09-X）=5111.51*1.09/2

X=0.3652 m

According to the calculation, the mass of the load at the rear of the screen is 1230.61kg, as shown in Figure 6-2-3.

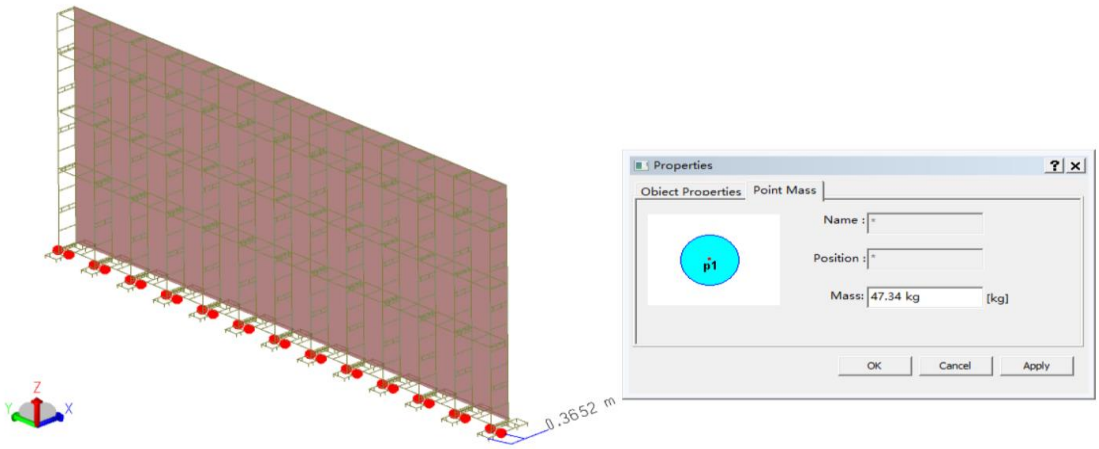


Figure 6-2-3 4-Level wind design load distribution (47.34kg*26)

At this time, the total weight of the LED screen is 5111.51 kg (including the load mass), the centre of gravity is 0.545m from the front feet and 0.545m from the rear feet, and the minimum tilting moment of the weight is 27319.1 N*m, which is equal to the tilting moment of the 4-level wind design load on the ground (27319.1 N*m).

In summary, under the design load of 4-level wind, it is necessary to add 47.34kg of counterweight (single) at the rear of the

LED screen, and configure 26 counterweights, with a total of 1230.61kg counterweight.

3. Loading distribution under Beaufort scale- 6 Level

Under the 6-level wind design load, the LED screen is at a risk of overturning regardless whether the wind direction towards the X-axis is positive or negative. It is necessary to load heavy objects at the rear of the screen structure. The mass of the weight 'M_min.' is calculated according to the following formula:

M_min*9.80665*1.09/2=83312.1

M_min=15588 kg

Therefore, the mass of the weight 'M' is calculated according to the following formula:

M=M_min-3880.9=11707.1 kg

The centre-of-gravity position of the weight is calculated according to the following formula:

3880.9*0.488+11707.1*（1.09-X）=15588*1.09/2

X=0.526 m

According to the calculation, the mass of the load at the rear of the screen is 11707.1kg, as shown in Figure 6-4-3.

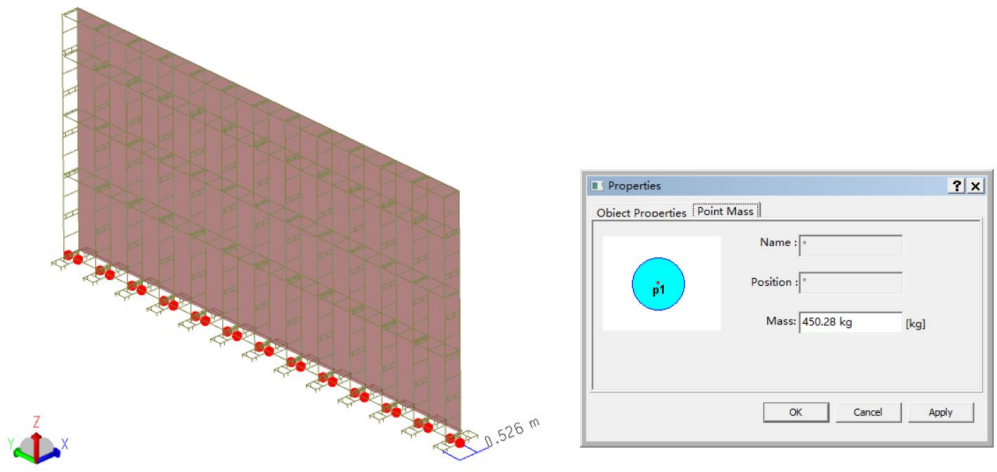


Figure 6-4-3 6-Level wind design load distribution (450.28kg*26)

At this time, the total weight of the LED screen is 15588 kg (including the load mass), the center of gravity is 0.545m from the front feet, and 0.545m from the rear feet. The minimum weight anti-overturning moment is 83312.1 N*m, which is equal to the tilting moment of the 6-level wind design load on the ground (83312.1 N*m).

In summary, under the design load of 6-level wind, it is necessary to add 450.28 kg counterweight (single) at the rear of the LED screen, and configure 26 counterweights, with a total of 11707.1kg counterweights.

4. Loading distribution under Beaufort scale- 8 Level

Under the 8-level wind design load, the LED screen is at a risk of overturning regardless whether the wind direction towards the X-axis is positive or negative. It is necessary to load heavy objects at the rear of the screen structure. The mass of the weight 'M_min.' is calculated according to the following formula:

M_min*9.80665*1.09/2=187396

M_min=35062.53 kg

Therefore, the mass of the weight 'M' is calculated according to the following formula:

M=M_min-3880.9=31181.62 kg

The centre-of-gravity position of the weight is calculated according to the following formula:

3880.9*0.448+31181.62*（1.09-X）=35062.53*1.09/2

X=0.5379 m

According to the calculation, the mass of the load at the rear of the screen is 31181.62kg, as shown in Figure 6-6-3.

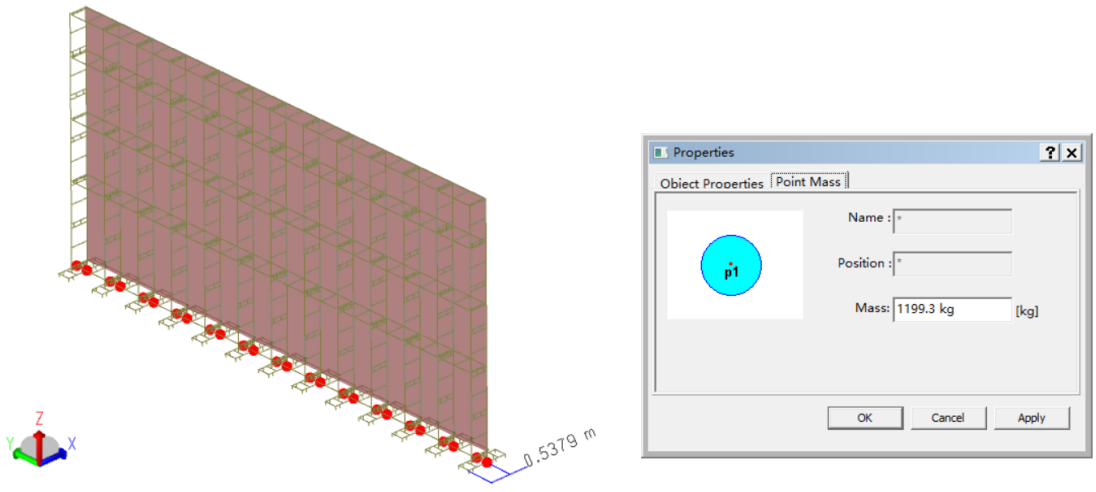


Figure 6-6-3 8-Level wind design load distribution (1199.3 kg*26)

At this time, the total weight of the LED screen is 35062.53 kg (including the load mass), the center of gravity is 0.545m from the front feet, and 0.545m from the rear feet. The minimum weight anti-overturning moment is 187396 N*m, which is equal to the tilting moment of the 8-level wind design load on the ground (187396 N*m).

In summary, under the design load of 8-level wind, it is necessary to add 1199.3 kg counterweight (single) at the rear of the LED screen, and configure 26 counterweights, with a total of 31181.62kg counterweights.

5. In conclusion

According to the above analysis results, the loading distribution of the LED screen under different wind levels is as shown in Table 7-1-3.

Table 7-1-3 LED Screen loading distribution

Installation Structure	Screen Size	Beaufort scale	Loading mass (kg)	Weight Quantity (pc)	Weight Location
Ground stacking	12 panels high x 24 panels wide (6m/19.65' H x 12m/39.3'W)	4-level wind design load	47.34	26	about 0.365m from the rear feet of the LED screen
		6-level wind design load	450.28	26	about 0.526m from the rear feet of the LED screen
		8-level wind design load	1199.3	26	about 0.538m from the rear feet of the LED screen

V. Screen size: 16 panels high x 30 panels wide, hanging Structure;

1. The total weight of the hanging LED screen is about 4291kgs, and the main size of the screen structure is about 0.064*15*8.041 m (dimensions in order of the finite element model X/Y/Z direction).

The structural analysis considers the following base loads.

a) Self-weight of the structure

b) Beaufort scale - 4 Level (standard wind pressure 40.3 Pa, considering three times safety factor, design wind pressure 121 Pa)

c) Beaufort scale - 6 Level(standard wind pressure 122.8 Pa, considering three times safety factor, design wind pressure 369 Pa)

d) Beaufort scale - 8 Level(standard wind pressure 276.4 Pa, design wind pressure 830 Pa considering triple safety factor).

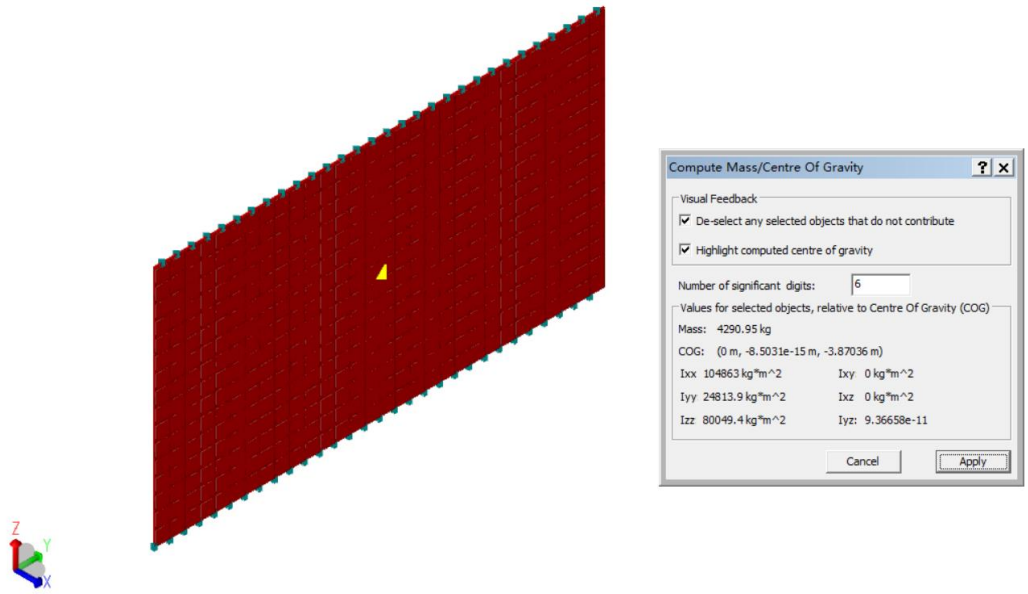
The analysis software name is called SESAM, which is a strength analysis software released by DNV in 1969. SESAM is the preferred structural design analysis tool for Marine and steel structures in the world. The software is a leader in the filed of Professional software design, research and development, risk assessment, analysis, equipment integrity management, engineering knowledge and used in many industries, such as shipbuilding, offshore engineering, petrochemical industry, etc.

The following software components were used in the analysis:

a) GeniE 64 V8.3-31 (create models, apply loads, and partition finite element elements)

b) Presel V7.5-01（combined load, combined finite element model）

c) Sestra 8.8-00 (FEA solver)



Display analysis model

2. Loading distribution under Beaufort scale- 4 Level

Under the 4-level wind design load, the wind load on X-direction is 14520N. The mass of the weight 'M' is calculated according to the following formula:

M*g*0.3=14520/2

M=2468 kg

It is recommended that the weight on the ground be evenly arranged along the bottom of the hanging LED screen. The length of the binding rope is based on the actual situation.

3. Loading distribution under Beaufort scale- 6 Level

Under the 6-level wind design load, the wind load on X-direction is 44280 N. The mass of the weight 'M' is calculated according to the following formula:

M*g*0.3=44280/2

M=7526 kg

It is recommended that the weight on the ground be evenly arranged along the bottom of the hanging LED screen. The length of the binding rope is based on the actual situation.

4. Loading distribution under Beaufort scale- 8 Level

Under the 8-level wind design load, the wind load on X-direction is 99600 N. The mass of the weight 'M' is calculated according to the following formula:

M*g*0.3=99600/2

M=16928 kg

It is recommended that the weight on the ground be evenly arranged along the bottom of the hanging LED screen. The length of the binding rope is based on the actual situation.

5. **In conclusion**

According to the above analysis results, the loading distribution of the LED screen under different wind levels is as shown in Table 7-1-4.

Table 7-1-4 LED Screen loading distribution

Installation Structure	**Screen Size**	**Beaufort scale**	**Total loading mass (kg)**	**Weight Location**
Hanging	16 panels high x 30 panels wide (8m/26.25' H x 15m/49.21'W)	4-level wind design load	2468	The weight on the ground be evenly arranged along the bottom of the hanging LED screen.
		6-level wind design load	7526	
		8-level wind design load	16928	