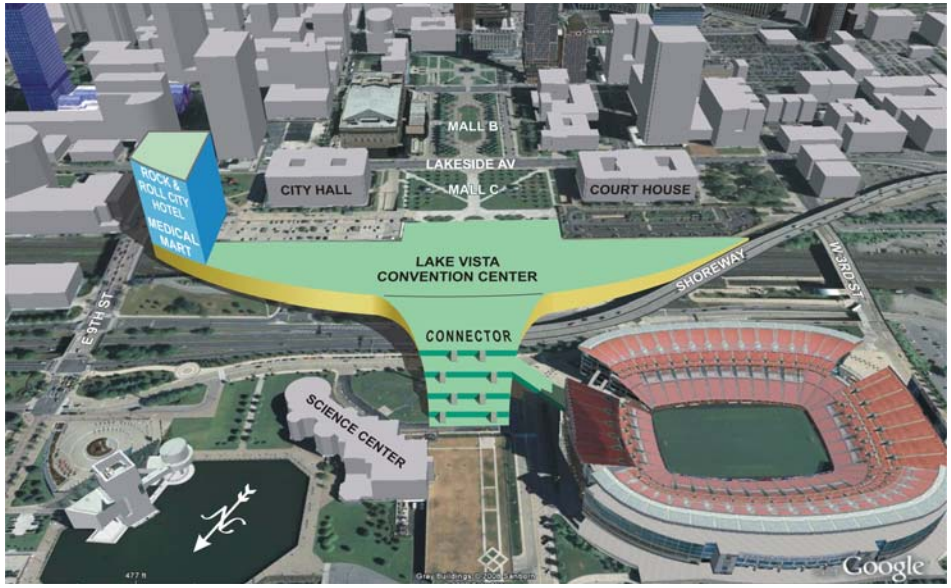


# Cost estimate of Cleveland's LakeVista Convention Center

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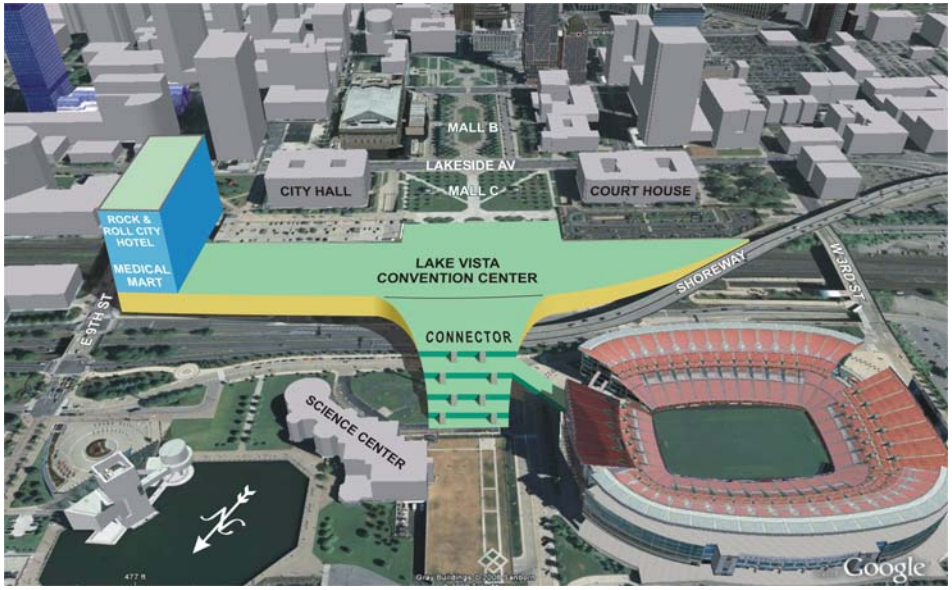


## Cost estimate of Cleveland's LakeVista Convention Center

This proposed Center is to be located to the north of Mall C, connect to the existing Convention Center, and bridge across the freight and passenger rail lines as well as the rapid transit tracks. It will have a lakefront connector across the Shoreway that will have a branch leading to the Browns Stadium to allow the use of its meeting room facilities to augment the options for conventions.

Since the Citizens' Vision proposed convention center building will be elevated above the rail lines like a bridge, and since it must withstand the weight of trucks, bridge figures were used to estimate cost. Two scenarios were considered using bridge cost estimating data from the Florida Department of Transportation:

http://www.dot.state.fl.us/ructures/StructuresManual/CurrentRelease/DesignGuidelines/SDG9.1General.htm

**NOTE**: *This analysis is strictly for the decks and supports. No finish work is included. No costs are included for the fireproofing of deck structures, or for the proposed multistory Medical Mart/Rock & Roll City Hotel building, or for the connector across the Shoreway.*

Florida DOT rough estimates per square foot for a continuous span concrete deck/steel girder bridge range from $135 to $170 per square foot. Using these figures, the range of estimates is as follows:

For the "Champagne" building; 403,000 sq. ft.:

Lower deck and supports only: $55 to $ 69 million.
Lower and upper decks and supports: $109 to $137 million

For the "Boat" building; 493,000 sq. ft.:

Lower deck and supports only: $67 to $84 million.
Lower and upper decks and supports: $133 to $168 million

To confirm the validity of these rough estimates, a detailed cost analysis of a design of the 493,000 sq. ft. building was performed. This design specified beam and girder sizes, deck thickness, caisson numbers, size, and locations as well as other details. The design is based upon 90-foot spacing of columns. The detailed analysis falls close to the high end of the estimate range, which helps give confidence in all of the figures.

Two independent sources were use for estimating the caissons. The two figures were within 12 percent of each other, giving confidence in their validity. The larger number was used for the analysis.

Conclusion of detailed cost analysis of the 493,000 sq. ft. building:

| | |
|---|---|
| Caissons and lower deck only: | $85 million |
| Columns and upper deck only: | $72 million |
| Total for both decks: | $157 million |

## COST AND LOAD-BEARING CAPACITY OF CAISSONS FOR "BOAT" CONVENTION CENTER

Height of caisson = 125 ft
Diameter of caisson = 5 ft
Cross-sectional area = $5^2 \cdot \pi/4 = 19.635\ ft^2 \approx 20\ ft^2$
Volume = $125 \cdot 19.635 = 2454\ ft^3$
Volume = $2454 / 27 = 91\ yd^3$
Cost per $yd^3$ = \$800
Cost per caisson = $91 \cdot 800 = \$72,722$
Spacing of caissons ≈ 90 – 110 ft (See drawing)
Number of caissons = 85

**Total cost:** \$6,181,370 ≈ **$\$6.2 \cdot 10^6$**

Bearing load = 3000 psi (from Osborne Report)
Load per caisson = $3000\ lb / in^2 \cdot 20\ ft^2 \cdot 144 in^2 / ft^2 = 8,640,000\ lb$

**Total load-bearing capacity:** $8,640,000\ lb \cdot 85 \approx$ **$734 \cdot 10^6$ lb**

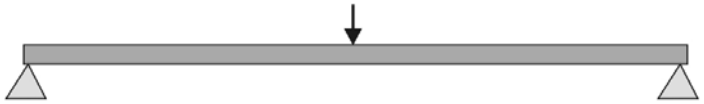
## STATIC LOAD CALCULATIONS:

Weight of deck = density of concrete • deck area • thickness
$150\ lb / ft^3 \cdot 493,000\ ft^2 \cdot 0.667\ ft = 49,324,000\ lb$

Steel I-beams W 24 X 250:
Weight = 250 lb / ft
Beam spacing = 4 ft
Beam total length: $493,000\ ft^2 / 4\ ft = 123,250\ ft$
Total beam weight = $123,250\ ft \cdot 250\ lb / ft = 30,813,000\ lb$

**1 deck load:** $49,324,000\ lb + 30,813,000\ lb \approx$ **$80 \cdot 10^6$ lb**
**2 decks load:** $89 \cdot 10^6 \cdot 2 \approx$ **$160 \cdot 10^6$ lb**
**Support girder load = $8 \cdot 10^6$ lb**
**Support I-beam load = $3 \cdot 10^6$ lb**
**Column load = $0.7 \cdot 10^6$ lb**

Using http://www.engineeringtoolbox.com/beam-stress-deflection-d_1312.html
Steel I-beam W 24 X 250:
Given a centered single load = 20000 (lb)
Length of Beam - L : 1200 (in)
Moment of Inertia - I : 8490 ($in^4$)
Modulus of Elasticity - E : 29000000 (psi)
Perp. distance from neutral axis - y : 13 (in)
Support Force - R1 : 10000 (lb)
Support Force - R2 : 10000 (lb)
Maximum Stress - σ : 9187 (psi)
Maximum Deflection - δ : 2.92 (in)



WEIGHT OF ONE SQUARE OF DECK (Supported by one column)

90ft x 100 ft = 9000 $ft^2$

9000$ft^2$ • 0.667 ft • 150 lb / $ft^3$ = 900,450 lb

WEIGHT OF ONE SQUARE OF I-BEAMS

(9000 $ft^2$ / 4 ft) • 207 lb /ft = 465,750 lb

TOTAL WEIGHT OF ONE SQUARE = 900,450 lb + 465,750 lb = 1,366,200 lb

COLUMN CALCULATIONS

(Steel column: type not specified, only cross-sectional area)

Weight of one square resting on one column = 1,366,200 lb + (3 • 18,270 lb) = 1,421,010 lb

Column cross-section for 20,000 psi stress ≈ 71.05 $in^2$

Weight of column = 71.05 $in^2$/144 $in^2/ft^2$ • 490 $lb/ft^3$ • 34 ft = 8220 lb

STRESS ON DUAL-GIRDER LOWER DECK SUPPORT BETWEEN COLUMNS (per girder)

24 in. flange; 72 in. height; 3 in. flange thickness; 1.5 in. web thickness; Cross-section - 243 $in^2$

Weight/ft – 243 $in^2$/144 $in^2/ft^2$ • 490 $lb/ft^3$ = 825 lb/ft; weight of 90-ft beam = 74,250 lb

Unit Load - q : 632 (lb/in) (Uniformly distributed load)

Total Load : 682560 (lb)

Length of Beam - L : 1080 (in)

Moment of Inertia - I : 195000 ($in^4$)

Modulus of Elasticity - E : 29000000 (psi)

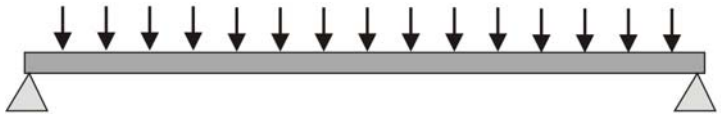
Perp. distance from neutral axis - y : 36 (in)

Support Force - R1 : 341280 (lb)

Support Force - R2 : 341280 (lb)

Maximum Stress - σ : 17011 (psi)

Maximum Deflection - δ : 1.98 (in)



STRESS ON TRIPLE-BEAM UPPER DECK SUPPORT BETWEEN COLUMNS (per beam)

W 40 X 503: 503 lb/ft. Weight of 90-ft beam = 18,270 lb

Unit Load - q : 422 (lb/in) (Uniformly distributed load)

Total Load : 455760 (lb)

Length of Beam - L : 1080 (in)

Moment of Inertia - I : 50400 ($in^4$)

Modulus of Elasticity - E : 29000000 (psi)

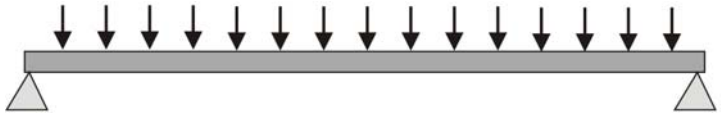
Perp. distance from neutral axis - y : 21 (in)

Support Force - R1 : 227880 (lb)

Support Force - R2 : 227880 (lb)

Maximum Stress - σ : 25637 (psi)

Maximum Deflection - δ : 5.11 (in)



**COST OF 493,000 $ft^2$ DECK** (Using *Florida Estimating Data Structures Design Guidelines Jan 2009 — 9 - BDR Cost Estimating*)

Cost of deck concrete: \$850/$yd^3$. 493,000 $ft^2$ • 0.667 ft /27 $ft^3/yd^3$ = 12,178 $yd^3$ 12,178 $yd^3$ • \$850/ $yd^3$ = \$10,352,000

Cost of reinforcing steel: \$1.25/lb; 205 lb of steel per cubic yard of concrete: 12,178 $yd^3$ • 205 lb/ $yd^3$ • \$1.25/lb = \$3,121,000

Subtotal of deck concrete/steel = \$13.473,000

**COST OF 493,000 $ft^2$ I-BEAMS** (Using *Florida Estimating Data Structures Design Guidelines*) +\$53,923,000

Cost of W 24 X 250 rolled wide flange sections: \$1.75/lb. \$1.75/lb • 30,813,000 lb = \$53,923,000 Total deck cost = **\$64,396,000**

**COST OF LOWER DECK SUPPORT PLATE GIRDERS** (Using *Florida Estimating Data Structures Design Guidelines*)

Number of 24" flange 67" web plate girders = 108
Weight of each girder = 825 lb/ft • 90 ft = 74,250 lb
Total weight = 74,250 lb • 108 = 8,019,000 lb
Total cost = 8,019,000 lb • \$1.80/lb ≈ **\$14,033,000**

**COST OF UPPER DECK SUPPORT I-BEAMS** (Using *Florida Estimating Data Structures Design Guidelines*)

Number of W 40X 503 I-beams = 184
Weight of each beam = 503 lb/ft • 90ft = 18,270 lb
Total weight = 18,270 lb • 184 = 3,361,680 lb
Total cost = 3,361,680 lb • \$1.75 lb ≈ **\$5,883,000**

**COST OF UPPER DECK COLUMNS** (Using *Florida Estimating Data Structures Design Guidelines*)

Number of columns = 85
Weight on each column = 1,366,200 lb + (3 • 18,270 lb) = 1,421,010 lb
Cross section = 1,421,010 lb/20,000 lb/$in^2$ = 71 $in^2$/144 $in^2/ft^2$ = 0.4934 $ft^2$
Weight of each column = 0.4934 $ft^2$ • 34 • 490 lb/$ft^3$ = 8220 lb
Total weight = 8220 lb • 85 = 698,700 lb
Total column cost = 698,700 lb • \$1.80 ≈ **\$1,258,000**

**COST OF DRILLED SHAFT [CONCRETE PILING] ON LAND** (Using *Florida Estimating Data Structures Design Guidelines*)

Cost = \$510 per linear foot for a 5-ft diameter piling
\$510/ft • 125 ft • 85 = \$5,418,750

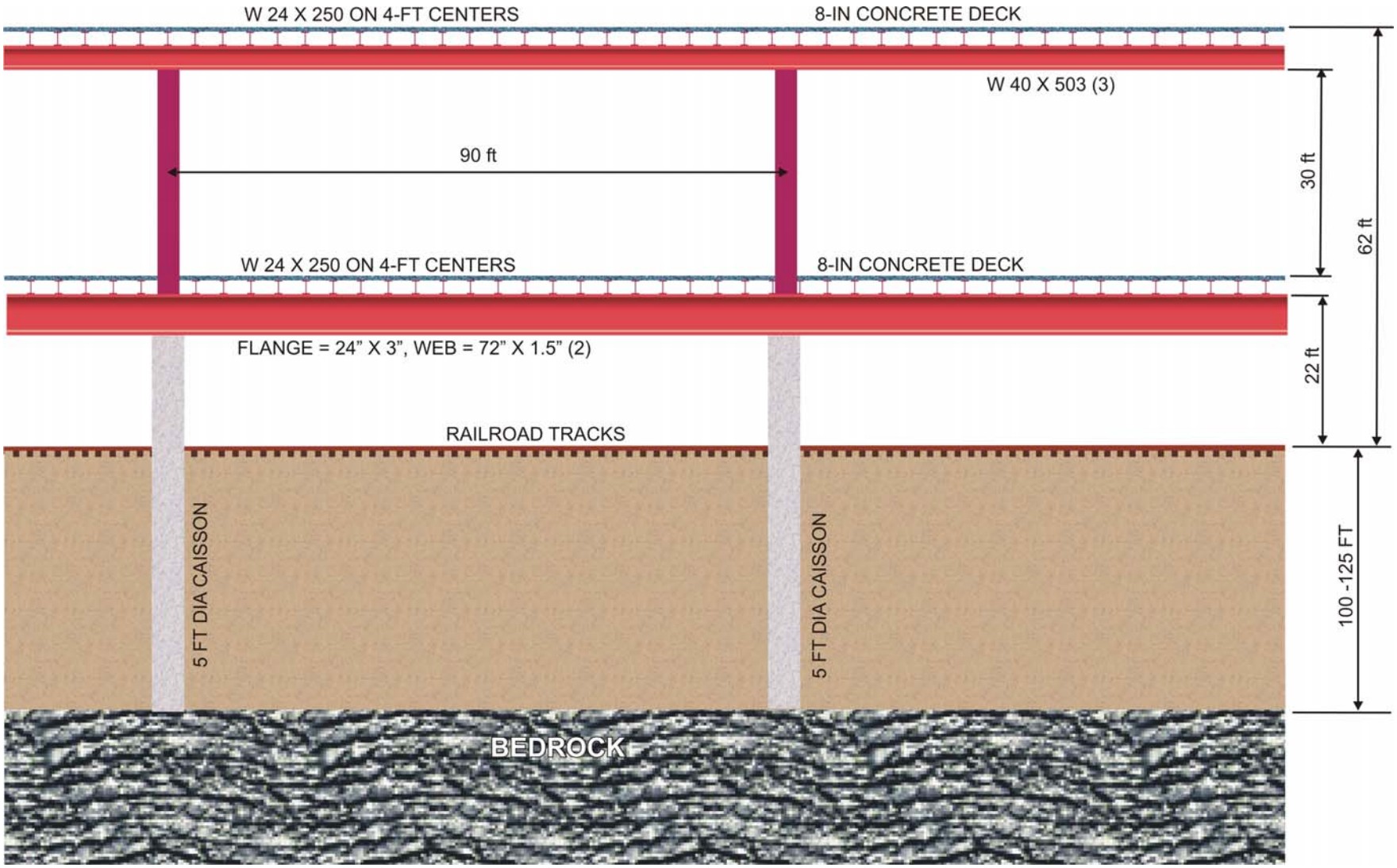
**COST OF CAISSONS USING OUTSIDE SOURCE FIGURE OF \$800 PER CUBIC YARD: \$6,181,000**

| **COST OF LOWER DECK ONLY** | | **COST OF UPPER DECK ONLY** | | **COST OF BOTH DECKS ("BOAT" DESIGN)** | |
|---|---|---|---|---|---|
| \$64,396,000 | Lower deck | \$64,396,000 | Upper deck | | |
| \$14,033,000 | Lower deck support girders | \$5,883,000 | Upper deck support beams | \$84,610,000 | Lower deck |
| \$6,181,000 | Pilings/Caissons | \$1,258,000 | Upper deck columns | \$71,537,000 | Upper deck |
| **\$84,610,000** | **TOTAL** | **\$71,537,000** | **TOTAL** | **\$156,147,000** | **GRAND TOTAL** |

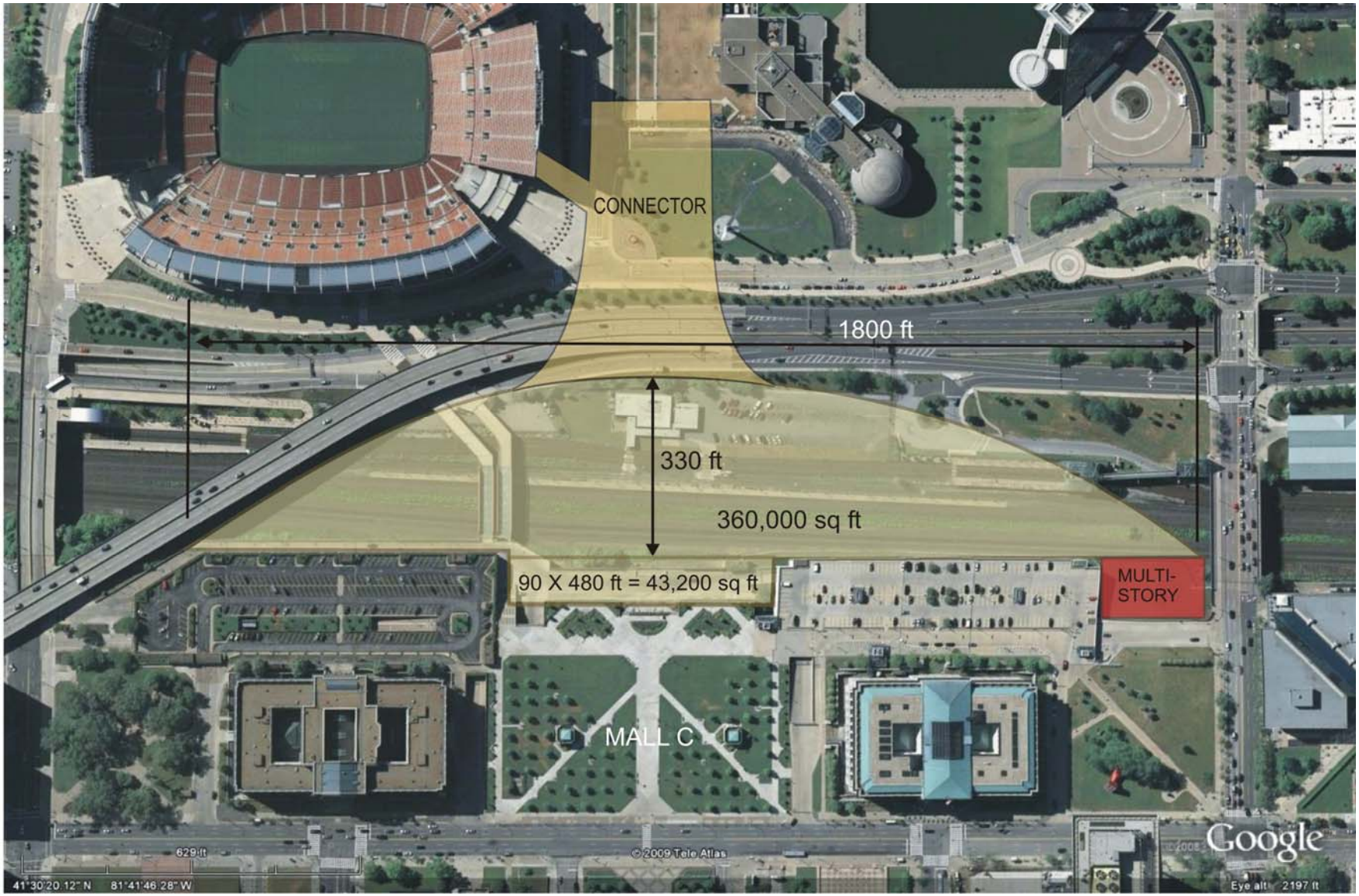
**NOTE**: 2007 Florida Rough Estimating data for Continuous Span Concrete Deck / Steel Girder Bridge

\$135/$ft^2$ low estimate For 2 decks: \$135/$ft^2$ • 986,000 $ft^2$ = **\$133,110,000**

\$170/$ft^2$ high estimate For 2 decks: \$170/$ft^2$ • 986,000 $ft^2$ = **\$167,620,000**

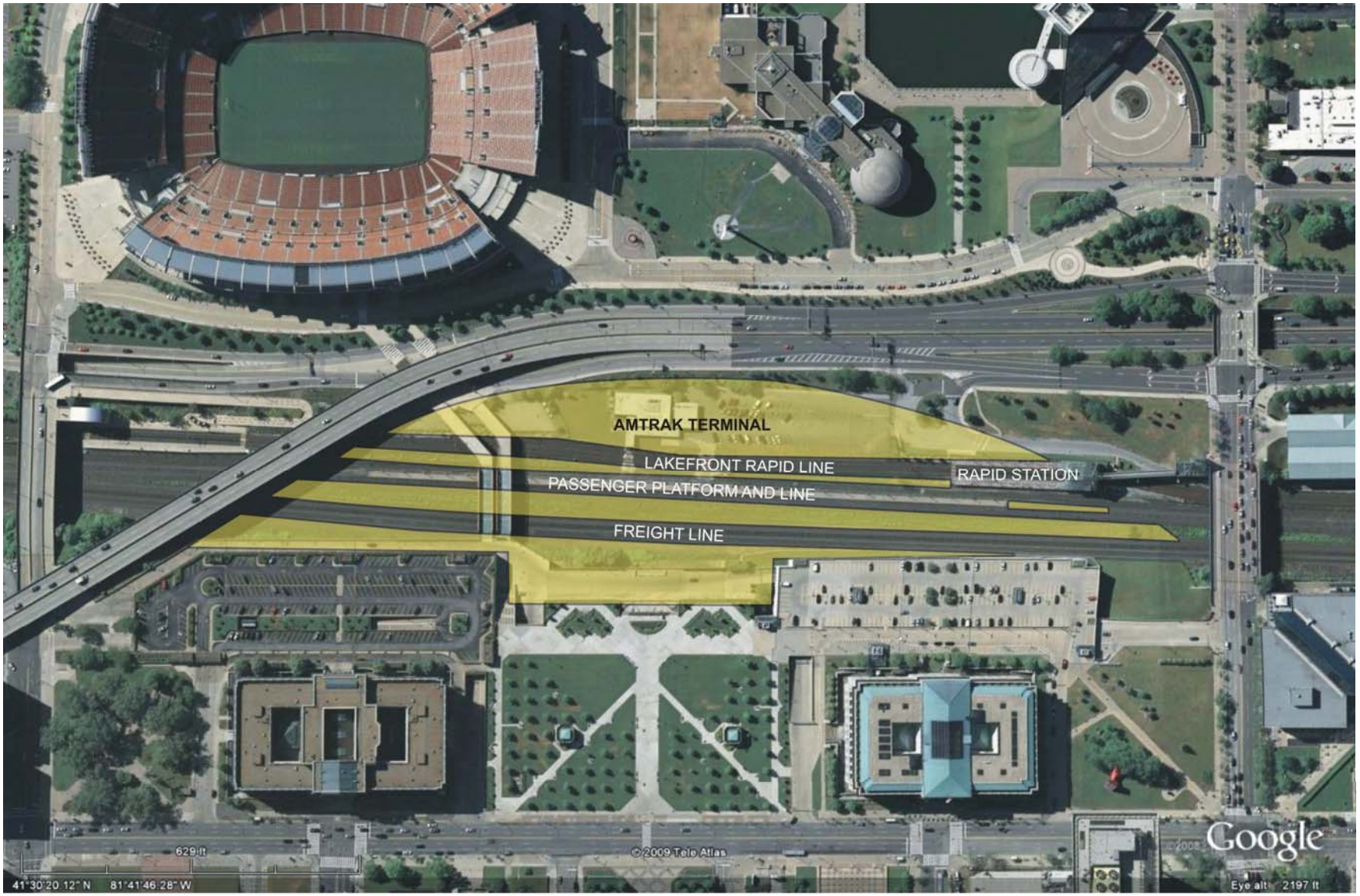



**SE/NW SECTION ELEVATION OF CHAMPAGNE / BOAT BUILDING FOUNDATION AND DECKS**

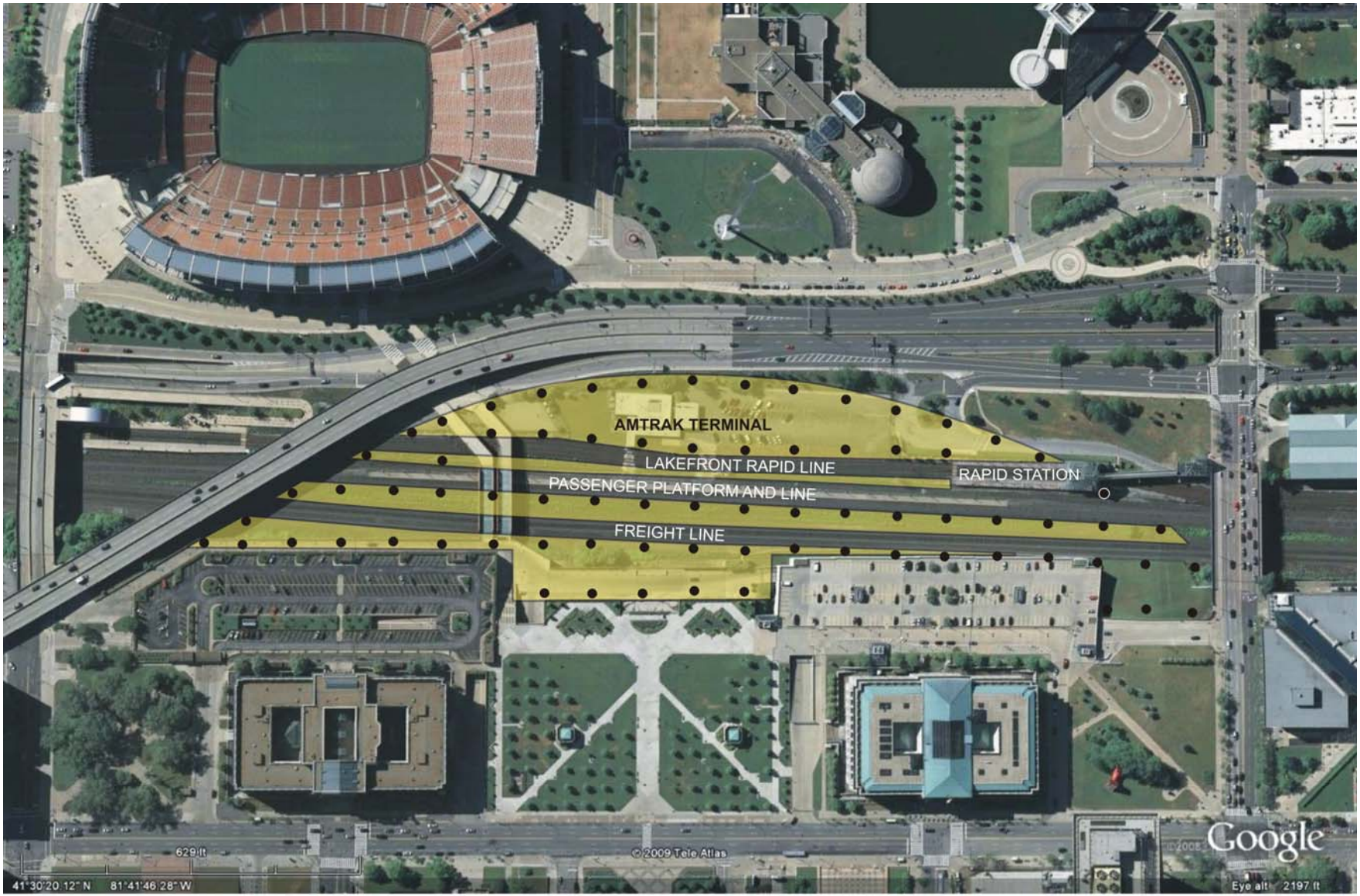



"TOAST OF CLEVELAND" CONVENTION CENTER BUILDING

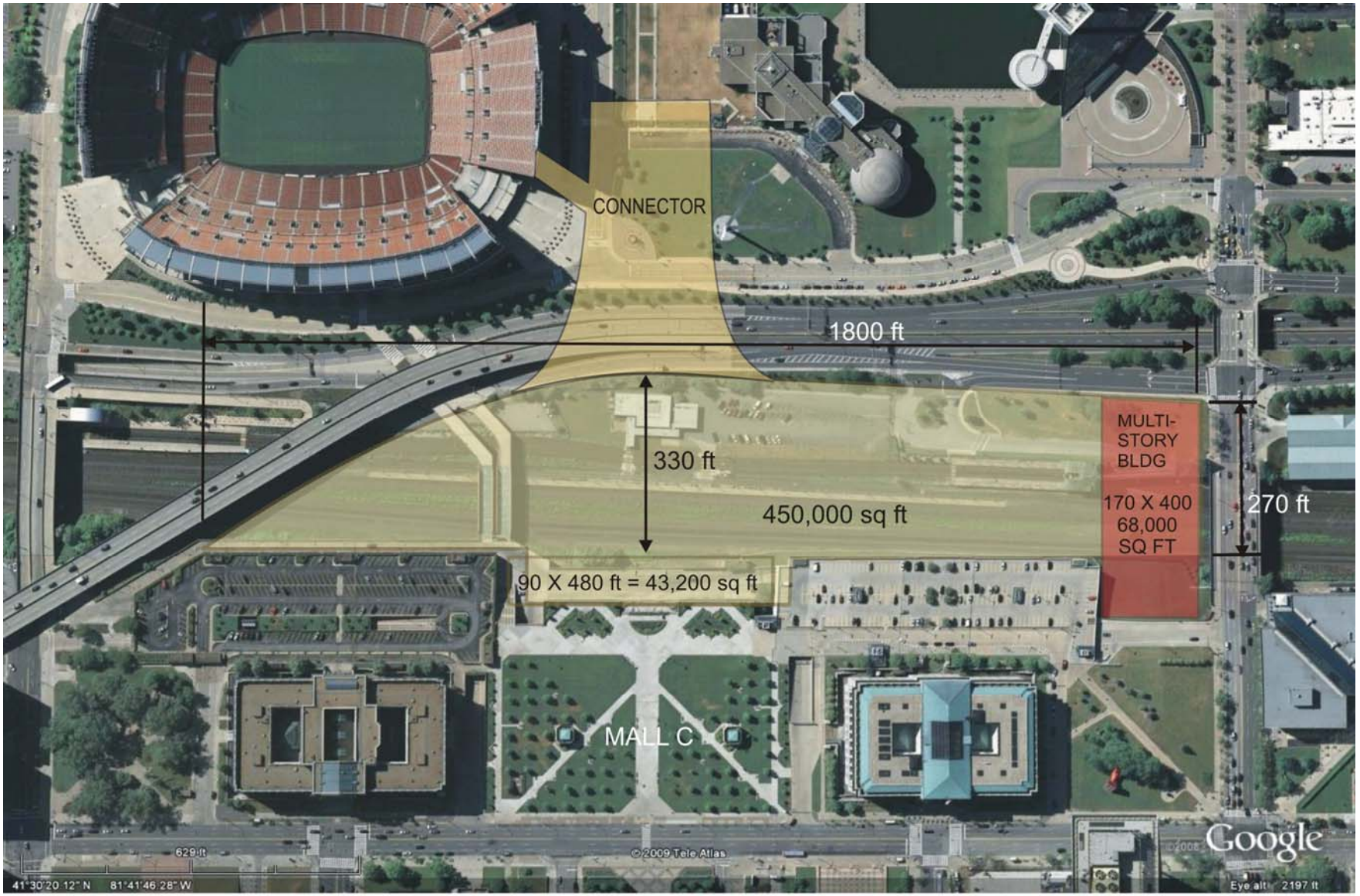
0 200 400 600 800 1000 FT




AREAS AVAILABLE FOR CAISSONS TO SUPPORT “TOAST” CONVENTION CENTER

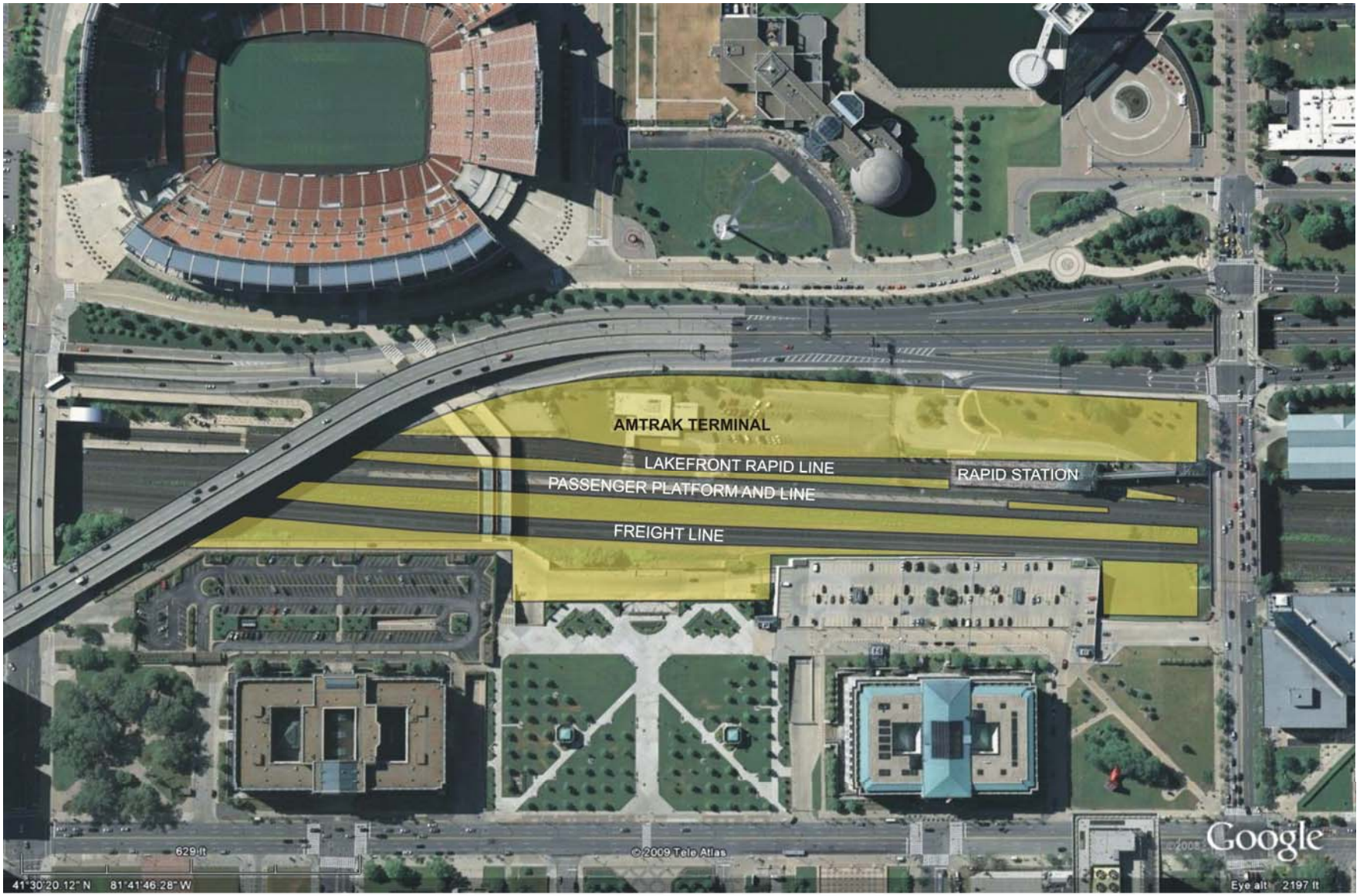



90-FT (APPROX) SPACING PATTERN FOR 74 CAISSONS FOR “TOAST” CONVENTION CENTER




BOAT SHAPE CONVENTION CENTER BUILDING

0 200 400 600 800 1000 FT




AREAS AVAILABLE FOR CAISSONS TO SUPPORT “BOAT” CONVENTION CENTER

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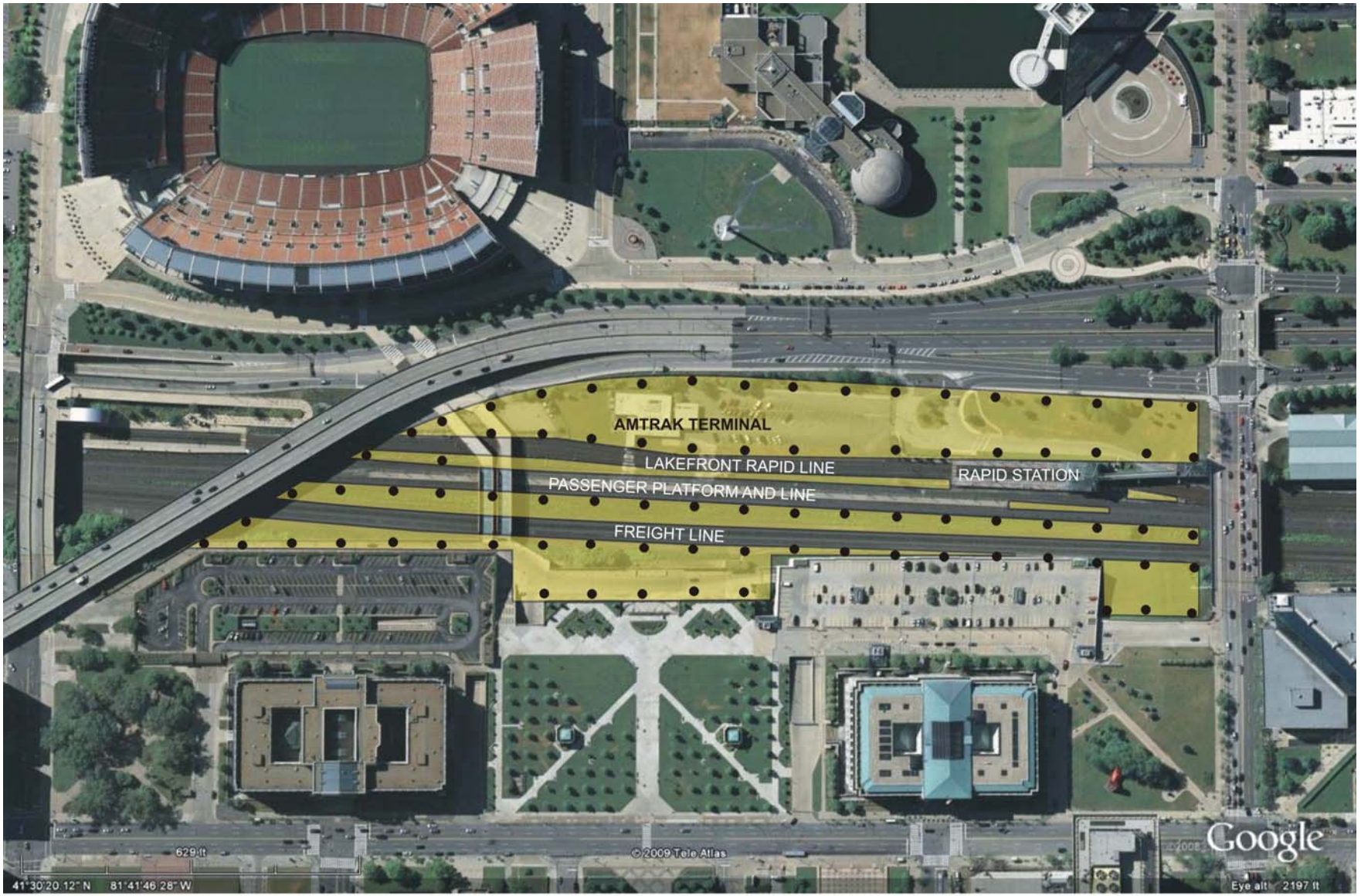


90-FT (APPROX) SPACING PATTERN FOR 83 CAISSONS FOR “BOAT” CONVENTION CENTER




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