Forrest E. Mars, Jr. Building at The Brinton Museum

Duncan Kline, PE
Malone Belton Abel PC
Course Description

The course will discuss the complicated hillside siting; the design and construction of the largest single rammed earth wall in North America; planning to provide a sense of airiness 40 feet underground; the interrelation of concrete, rammed earth, weathering steel, fiberglass reinforced concrete panels and copper bar stock; a near-miss involving polished concrete flooring; and why we decided a LEED rating would be irrelevant.
Learning Objectives

1. At the end of this program, participants will be better able to prepare conceptual designs with an emphasis on integration into the natural environment that de-emphasizes the building exterior to the benefit of the building interior and design as a whole.

2. At the end of this program, participants will be ready to discuss with their Structural Engineers the use of Geofoam blocks in deep soil construction and why it is relevant to freeing up the building’s architecture.

3. At the end of this program, participants will be able to design with rammed earth; whether structural or non-structural, insulated or non-insulated. You will learn problems to avoid as well as a number of specific requirements to include in your drawings and specifications.

4. At the end of this program, participants will be able to list a number of critical topics in museum design, such as: planning for gallery spaces as either “building environments” or black boxes;” critical back-of-house design parameters; understanding environmental requirements of museums.
Forrest E. Mars, Jr. Building

- exhibition galleries
- collection storage
- office and work areas
- bistro

- 24,000 SF
- 3 levels
- $15.9 million
Hillside Siting

The Client wanted the new building buried in the hillside so it would not overwhelm the historic ranch setting.
Lateral Earth Pressure on Exterior Walls

45 FT MAX BACKFILL

3,940 PSF AT BOTTOM OF WALL

REACTION AT ROOF
= 1,500 LBS/FT

REACTION AT LEVEL 3
= 16,100 LBS/FT

REACTION AT LEVEL 2
= 49,600 LBS/FT

REACTION AT LEVEL 1
= 23,000 LBS/FT
8" OF PEA GRAVEL BTWN GEOFOAM AND BUILDING INSULATION

STEPS AT UNDERSIDE OF GEOFOAM TO BE MIN. OF 3.2

ROOF - WEST
45' - 6"

LEVEL 3
32' - 0"

LEVEL 2
16' - 0"

LEVEL 1
0' - 0"

SLOPE TOP OF BACKFILL UNDER PEA GRAVEL 2%

PEA GRAVEL LEVELING COURSE
8" MIN. OF PEA GRAVEL AT EAST END

SLOPE OF EXCAVATION

UNDISTURBED SOIL

SLOPE OF EXCAVATION

MOULDED SHEET [DRAINAGE PANEL]

BOTTOM OF EXCAVATION
Planning for gallery spaces as either “black boxes” or “building environments”

The Brinton Museum’s relation to its site, to the earth, and to the exhibits within it required a building sensitive to the exhibits and very much part of the experience of viewing and understanding those exhibits.
Understanding environmental requirements

The American Association of Museums (AAM) has standards concerning items such as temperature, relative humidity, protection of exhibits below pipes and fresh air filtration.
Critical back-of-house design parameters

- A fine museum requires a fine bistro
- Loading dock must accommodate loading and unloading semi tractor trailers
- Zero VOC levels for permanent exposed materials
- All LED lighting to get zero UV levels on exhibited materials
- Near zero levels for off-gassing construction materials is desirable
Rammed Earth
Weathering Steel
Fiber Reinforced Concrete Panels
Copper Bar Stock
Polished Concrete vs. Cushioned Resilient Tile
Jiayuguan Wall - Rammed Earth
Stabilized Rammed Earth (SRE)

- improved strength and durability
- 5% - 10% cement
- reduced clay content
- interstitial insulation
- steel reinforcement
- mechanized construction
- colored oxides
- 2 ft thick; 51 ft tall; 200 ft long
- compressive strength = 3,000 psi at 100 days
- typical reinforcement = #5 @ 16” horiz and vert; each face
- construction cost = $1.2 million = $2,600/CY
Structural Design – Stabilized Rammed Earth

Codes and Standards
▪ no national building code requirements or adopted standards
▪ New Mexico Earthen Building Materials Code
▪ ASTM E2392  *Structural Guide for Design of Earthen Wall Building Systems*

Structural Design Procedure
▪ used established methods for reinforced concrete and reinforced solid masonry design
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<th>Soil B Percent Retained</th>
<th>Combined Percent Retained</th>
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**Supplier:**
- **Soil A:** Paul Garber
- **Soil B:** Mullinax Sand
- **Parts:** 1

**Notes:**

**Summary**

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<th>Blend Name</th>
<th>% Cement</th>
<th>Kryton</th>
<th>SBA</th>
<th>Iron Oxide</th>
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<td>10%</td>
<td>2% of cement</td>
<td>1/2 Litre/Meter</td>
<td>1.5-3.5% of cement</td>
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![Graph](image-url)
FORMWORK SCHEMATIC

- L8x8x1/2" @ 16'-0" o/c (MIN 3)
- C9x15 w/ 1/4" PL. CAP EACH END
- TOP OF SPLICE 8'-0" MAX
- 2x8 STUDS @ 16" o/c
  DFIR. GRADE NO. 1
- 2-2x8 BLOCKING @ 4'-0" o/c
- NO SPLICE ZONE
- LIFTING EYE WITH HOLDDOWN
- LATERAL BRACING
- MAX HEIGHT 28'-0"
- 5/8" PLY EACH SIDE
- ASTM A325 1-1/2" BOLT
- MAX LENGTH 32'-0"
- W10x33 w/ 1/4" PL. CAP EACH END
  WELDED 1/4" PLATE x 10" LG @ 16" o/c AT BOTTOM
Comments and Questions