

A photograph of a modern high school gymnasium building. The building has a light-colored, textured facade and large glass windows. The word 'ATHLETICS' is prominently displayed in large, raised letters above the entrance. The sky is clear and blue.

# Structural Design Example High School Gymnasium

This Bautex Engineering Report provides an example of the structural engineering details and design considerations for constructing a representative project using Bautex Block as a load-bearing wall system. This example utilizes accepted engineering design models and calculations, but is not intended to be used as plans for the construction of an actual building, and does not take the place of actual engineering design.

## PROJECT BACKGROUND

Athletic facilities are an important priority for many school districts today, but they also represent an increasing challenge to design and construct within budget and on time. More demanding building energy and safety codes and ever increasing costs of operation are requiring new building designs and the adoption of higher performing building materials.

Bautex Block, a Composite Insulating Concrete Form (ICF) wall system, is very well suited for the construction of athletic facilities based on their cost effectiveness, speed of construction, durability, life safety and energy efficiency performance.

In this example Bautex Block is used to construct a single story high school gymnasium building with a total wall height of 42'-8", with a roof diaphragm located at 40'-0", and a 2'-8" tall parapet section. Building depth is 50'-0" with no interior load bearing walls. Roof loads are carried by the front and back walls, and both side walls are non-load bearing.

The front and rear of the building include two 8'-0" wide by 7'-0" tall openings for doors and windows. There are no other openings in the other two walls.

## PROJECT SPECIFICATIONS

### Building Summary:

Type: High School Gymnasium  
Stories: 1  
Roof Height: 40 feet  
Total Wall Height: 42.67 feet  
Building Depth: 50 feet

### Loading:

Roof Live Load = 20PSF  
Roof Dead Load = 10PSF  
Wind Load:  
Out of Plane = 25PSF

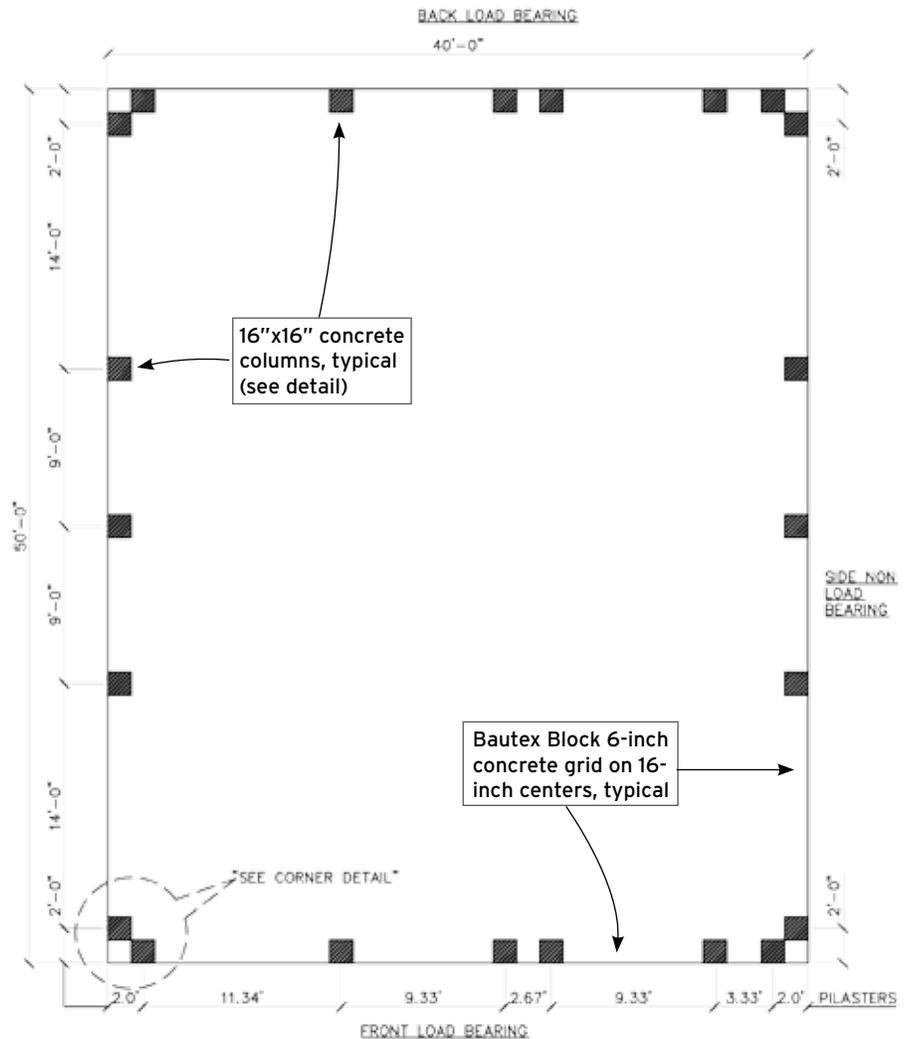
### References:

ACI 318-2011  
2012 International Building Code (IBC)

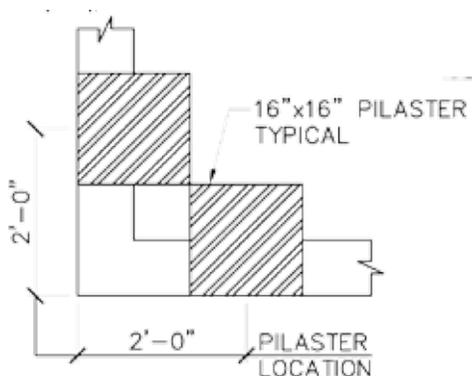


## PLAN VIEW

Lateral deflection controls the structural design of the gymnasium. This engineering example uses 16-inch concrete pilasters every 14'-0" maximum, including at corners and openings.



## CORNER DETAIL



## ENGINEERING DESIGN

The structural design for the example gymnasium building was done using a RISA 3D model and design calculations from ACI 318. The eccentricity at the top of the wall was assumed to be 5-1/2 inches.

In this case, the model showed that lateral deflection ( $L/360$ ) controls design of the structural members due to the height of the wall. The standard concrete grid in the Bautex Block carries much of the load on the walls, however the walls must be augmented with 16-inch concrete pilasters at 14-foot maximum spacing, as well as at certain locations like corners and openings.

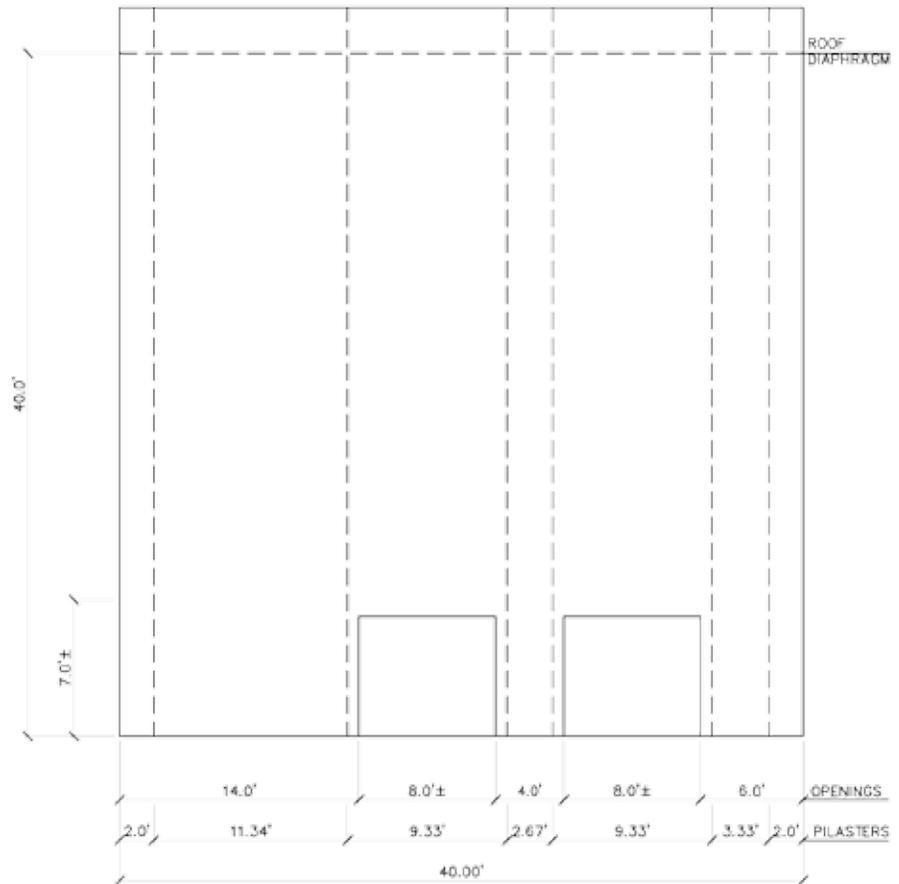
Concrete specified for this project was 4,000 psi structural concrete at 8-9" slump and 3/8" maximum aggregate for all the walls, including pilasters. Bautex Block grid and enhanced beams and columns are poured at the same time.

### Screen Grid

Bautex Block provides standard 6-inch cylindrical concrete columns and beams on 16-inch centers throughout the wall section. In these areas, #5 reinforcement bar was specified in all the Bautex cores, both vertically and horizontally.

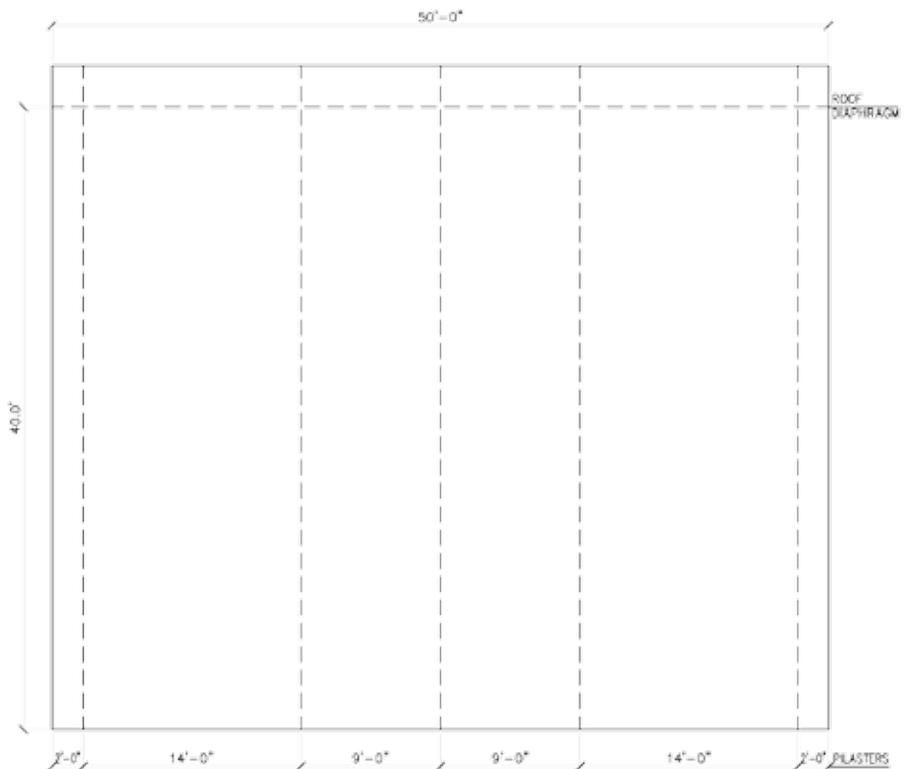
## FRONT ELEVATION

The roof height is 40'-0", with total wall height of 42'-8". This sample design strategically locates the 16-inch pilasters on either side of openings on the front and rear load bearing walls.

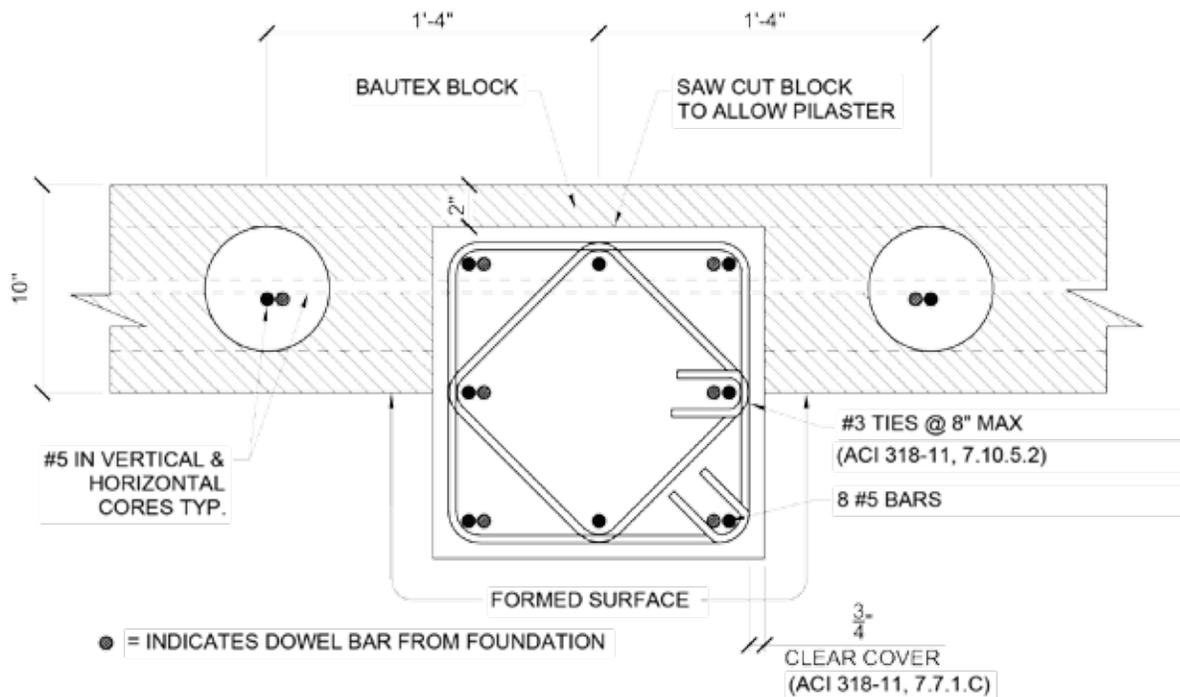


## SIDE ELEVATION

The non load-bearing sides of the gymnasium require 16-inch pilasters on 14'-0" centers. With a building depth of 50'-0", five pilasters are required on each side of the building.



## 16" PILASTER DETAIL



### Enhanced Concrete Elements

To provide enhanced structural capacity for the walls where required, the design calls for the construction of 16-inch concrete pilasters using a cage of eight #5 reinforcement bar vertically connected together with #3 reinforcement bar ties at 8-inch centers, as shown in the pilaster detail.

The pilasters are formed using Bautex Block and standard concrete shoring. The pilasters are connected to the Bautex concrete grid on either side by passing reinforcement bar horizontally through the pilaster (see Pilaster Detail).

On the front and rear load bearing walls, pilasters are located on both sides of each punched opening and just off the corners. There are four pilasters around the two openings, and a total of six pilasters on both the front and rear of the building.

The pilasters on the non load-bearing walls are located just off each corner and three pilasters spaced in the middle of the wall, for a total of five pilasters on each wall.

### RESULTS

In this example project, all of the exterior load bearing walls were constructed using concrete and Bautex Block. Other supplemental structural systems were not required. The ability to use a single wall system to provide the structure, building envelope, and insulation significantly simplifies and speeds up construction, and can help to reduce overall project costs.

In addition to structural capacity and design flexibility, the patent-pending Bautex Block provides R-14 continuous insulation and thermal mass, 4-hour load bearing fire rating, very low noise transmission STC of 51, and is a FEMA 320/361 compliant safe room material. Bautex Block is manufactured in San Marcos, Texas.

### BAUTEX ENGINEERING SERVICES

The structural design of the Bautex Wall System is based on widely understood specifications from the American Concrete Institute's Building Code Requirements for Structural Concrete - ACI 318. For more information, consult the Bautex Wall System Design & Engineering Guide.

To streamline and make your design process more efficient, Bautex does offer to have a completely engineered wall system with sealed structural engineering plans provided for your next project.

For more information on engineering design and solutions, visit the Bautex Systems website or contact our sales and construction support teams.



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