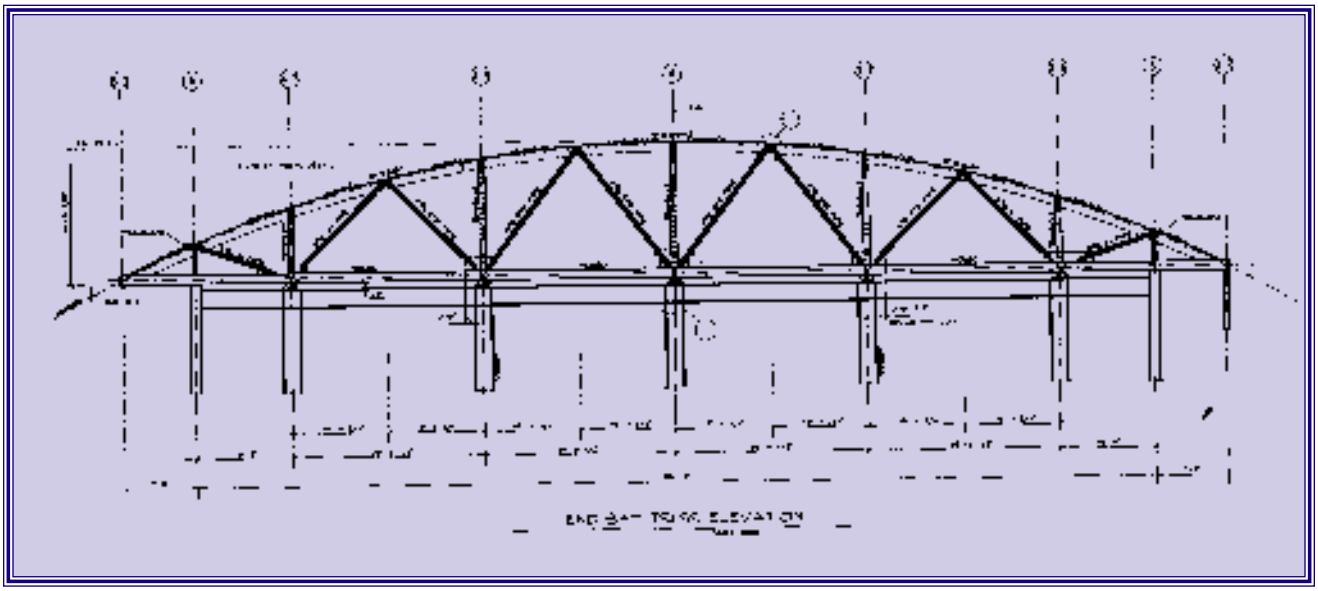
Golden State Warriors Training Facility

Oakland, California

After the National Basketball Association Golden State Warriors relocated from San Jose to a new arena in Oakland, the owners decided to consolidate their offices with a new training facility. The city of Oakland offered them the roof of their existing convention center building—then an automobile parking level—as the new site. The Warriors' program called for practice courts with a 100' clear span and 30' clear ceiling height, corporate offices with coaches' offices overlooking the courts and locker rooms, health spa and storage facilities.

The four-story steel-framed convention center was built in the early 1980s. The ground floor, with a clear span of 156', is used as a convention space. The existing structure uses a 10' deep plate transfer girder to support the three levels of parking



above to provide the 156' clear span. San Francisco-based Structural Design Engineers' investigation of the existing structure showed that it had excess capacity in its lateral two-way steel moment frame system, as well as the major column foundations supporting the convention center transfer girders. The excess capacity in the lateral frame was a result of the 1980s design practice of using non-standardized response spectra, which resulted in a higher level of seismic excitation than the 1994 Uniform Building Code criteria. Since the original construction complied with the ductility requirements of the current code, the lowered base shear for the building allowed for a light structure of a limited weight (not exceeding 11% of the existing building mass) to be placed upon the roof of the existing building. The existing concrete pile foundations for the major columns supporting the transfer girder had been conservatively designed such that a limited capacity for additional new loads was available for the proposed addition. The transfer girder could take a small additional load provided the loading was close to its supports. Finally, the columns and moment frame girders of the convention center were sized for seismic drift for a force level larger than the current code standards.

In summary, the challenges to the design team were:

- Vertical addition of a light two-story volume structure on an existing occupied structure with minimal or no disruption

in operations.

- Meet the Warriors' program requirements for the facility.

The structural engineers, in conjunction with Oakland-area architect Charles F. Jennings Architects, achieved the program requirements within the structural constraints of the existing building. They used structural steel bowstring trusses spanning 104' to provide the clear spans for the courts. Lightweight steel decking, insulation and metal roofing were used to keep the weight to the required minimum loads. The partial upper 6th floor for the corporate offices was hung from the roof trusses. By so doing, all gravity loads were placed near the transfer girder supports and on the heavy existing building columns.

To match the lateral system characteristics, the new structure utilized perimeter moment frames. Two innovative concepts were utilized to meet these requirements. The first was the use of the truss bottom chord as a collector of seismic loads to be delivered to the steel moment frame through a pin connection. The second innovation was the use of a coupled girder at the 6th floor to reduce weight of girders and columns. Because the new columns could not be rigidly connected to the top of the existing building box columns, the tall, 17.5'- height of the addition posed a stiffness problem. This was solved by the use of two girders at second floor and by coupling of the girders to create a stiffer structure. The coupling of the girders was achieved by vertical links at one-third of the girder spans. The coupled girders formed a Vierendeel truss, providing higher stiffness and reducing the effective height of the 17.5' tall first story columns. At 9', the door and window head allowed more than 7' for the depth of the coupled girders. A plate girder of that depth not only would have been expensive, but also would have violated the concept of strong column - weak beam, a ductility concept essen-

tial to seismic performance of structures.

In summary, design solutions to the challenges include:

1) Use of steel trusses and metal decking to deliver the loads close to existing columns, which carry the transfer girder to the heavy foundations.
2) Innovative use of a coupled-girder moment frame system to reduce steel weight and increase efficiency of the moment frame system.
3) Reduction of total weight of the addition by using steel roof trusses and metal decking. Also, by using 2" metal deck and 2 1/2" lightweight concrete for the partial second floor of the addition, thus keeping the added weight of the 56,000 sq. ft. addition within the required 11% excess capacity of the existing structure.
4) Innovative combination of trusses and moment frames at the roof, where the diagonals and bottom chord of the truss were used to deliver the seismic and wind loads to the moment frame through a pin connection.
5) Special erection techniques were developed to manage the placing of trusses, which were shipped in two segments and assembled on the roof. The erection sequencing allowed the dead loads to be transferred to the 104' span before welding of the moment frames. The transverse moment frames do not impose significant gravity loads on the transfer girder below even though the moment frame column spacing is approximately 21'.

The project was successfully completed in 1998, and is currently occupied by the Golden State Warriors.

Project Team

Owner:
The Golden State Warriors

Structural Engineer:
Structural Design Engineers, San Francisco

Architect:
Charles F. Jennings Architects, Oakland

General Contractor:
Dinwiddie Construction Co., San Francisco