The Newscastle

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Seven Oaks Dam Dedication

NO MORE DAM WORK

Eagle's View

By COL JOHN P. CARROLL
DISTRICT ENGINEER

To the entire Los Angeles district team:

It is a rare thing in our careers to be able to celebrate the completion of a project like seven Oaks Dam. Each of us has their own reasons for having joined this Corps of Engineers but I think that, over time, with the experience that our careers in the Corps brings to us all, we learn of and then come to understand the deeper, broader purposes and meaning of the mission of the Corps of Engineers. It is really about serving our neighbors and our country by accomplishing tasks that no-one else could; tasks to alter our physical environment to make it safer for all; or to provide for the facilities that support the defense of a land of opportunity such as ours; or to ensure the viability of navigation to a nation of traders, making it easier for all to make a living for our families and for the promise of our children's' future. Events like the Seven-Oaks dedication bring all that home with crystal clarity.

Well over ten years ago, the counties of San Bernardino, Riverside, and Orange, together with the Los Angeles District, began the actual fieldwork and construction that resulted in the magnificent edifice to the art and science of engineering that is Seven Oaks Dam. At that time, many of you had already been members of the LA team for many years. And, over that ten years, each and every one of you has played a role it making Seven Oaks possible. If you provided the personnel, the vehicles and supplies, the computers, the safety, the security, the publicity, the real property, the legal support, the contracts, the accounting, the small business support, ... your efforts were just as important as the planners, the project managers, the engineers (H&H, the keepers of the flame!) and the construction/operations crew. We could not have succeeded without every one of those skills represented on our team.

I truly wish that everyone in the district could have been at the ceremony, to receive the credit and recognition you deserve. I felt very small next to the role that any one of you has played in building that truly beautiful structure. And to think there may never be another!

My sincere congratulations and thanks,

John P. Carroll

Dear Colonel Carroll:

My sincere appreciation to the entire Los Angeles District team for its outstanding planning and execution of the Seven Oaks Dam dedication ceremony. The event was first class in every respect and reflected the hard work of many dedicated employees.

It is a rare opportunity that we have to dedicate projects of this size and complexity in the Army Corps of Engineers today. Your staff, working in concert with our three sponsors, ensured that every aspect of the ceremony was carried out professionally. Those involved have every reason to be proud of their accomplishments. No detail went unattended. The entire event reflected the attention to detail that is required in conducting highly visible ceremonies that are attended by such a large and diverse group of local and national dignitaries.

This is a stellar example of teamwork. It brought together diverse staff elements in the district and all worked together to make the event happen. My thanks to all involved.

Sincerely,

Peter T. Madsen
Brigadier General, U.S. Army
Division Engineer

Great Team Effort!"

SecArmy, congressman dedicate Seven Oaks Dam

Story by Herb Nesmith

An era drew to a close for the U.S. Army Corps of Engineers on January 7 with the dedication of the Seven Oaks Dam. The dam is probably the last large-scale dam the Corps will build in the foreseeable future. The project, managed by Los Angeles District, is a key piece of the Santa Ana River Mainstem Flood Control Project that will provide dramatically greater flood protection to more than three million residents and 255,000 structures in the Los Angeles area.

"The project is going to protect the Southern California area from the most severe flood that could occur here and damage three million homes, businesses, (and) properties," said Secretary of the Army Louis Caldera after the dedication. "It would cut our north-south freeways, (and) impact our entire nation. This is probably one of the last great dams that we'll build in the United States in the foreseeable future. There are no more on the drawing board."

"Today's ceremony is a celebration of many partnerships working toward a single goal -- flood protection for residents of Orange, Riverside, and San Bernardino counties that reside along the Santa Ana River Mainstem," said Brig. Gen. Peter Madsen, South Pacific Division Commander. "Each of the counties stood up to the table, put their signatures on the line, and pledged to share in the costs of the $1.4 billion project. They have put their stamp on this project and have been with us through every facet, and worked with us on every challenge."

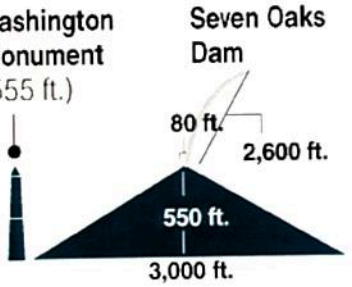
The official groundbreaking for the dam was in January 1991, the embankment contract was awarded to Odebrecht Contractors of California in March 1994, and the structure reached its maximum elevation last June. More than 3.5 million hours of work went into construc

The guest speaker for the Seven Oaks Dedication Ceremony was the Secretary of the Army Louis Caldera, left, shown with Congressman Joe Baca and Congressman Jerry Lewis, in whose district the dam is located.

South Pacific Division Commander Brig. Gen. Peter T. Madsen, left, presented several Commander's Coins including a special Seven Oaks Coin depicting the completion of Seven Oaks Dam to Paolo Suffredini, project manager for Odebrecht Contractors of California, center, and Terry King, resident engineer.

A Sleeping Giant

Seven Oaks is the largest flood-control dam in the United States. The embankment consists of 38 million cubic yards of material.



OVERVIEW

Filled with earth and rock, Seven Oaks Dam is built entirely of natural materials. It is meant to be dry until flood conditions exist.

Inside the Dam

The embankment is divided into eight sections, each with a different composition.

- **DOWNSTREAM SLOPE PROTECTION:** Crushed rock
- **ROCK FILL:** Coarse rock
- **INCLINED DRAIN:** Crushed gravel provides drainage.
- **ROCK TRANSITION:** Fine rock fill
- **CORE:** Impervious clay acts as dam's water stop.
- **FILTER** Separates rocks from clay, seals cracks appearing in clay layer.
- **ALLUVIAL TRANSITION** Uncrushed river rock.
- **ARMOR ZONE AND UPSTREAM SHELL** Boulders, crushed river rock

Core Trench: 100 feet deep. Contains **grout curtain**, a series of deep holes pressure-injected with cement grout control water passing underneath dam.

150'

Air shaft

5 Plunge pool

4 Gate chamber

2,000 ft.

3 Outlet tunnel

2 Intake Tower

500 ft.

Underground concrete sill and terraced sides provide erosion protection.

Spillway

Handles water levels exceeding dam's capacity During a 350-year flood, water levels would be high enough to go through spillway. Elevation: 2,580 feet.

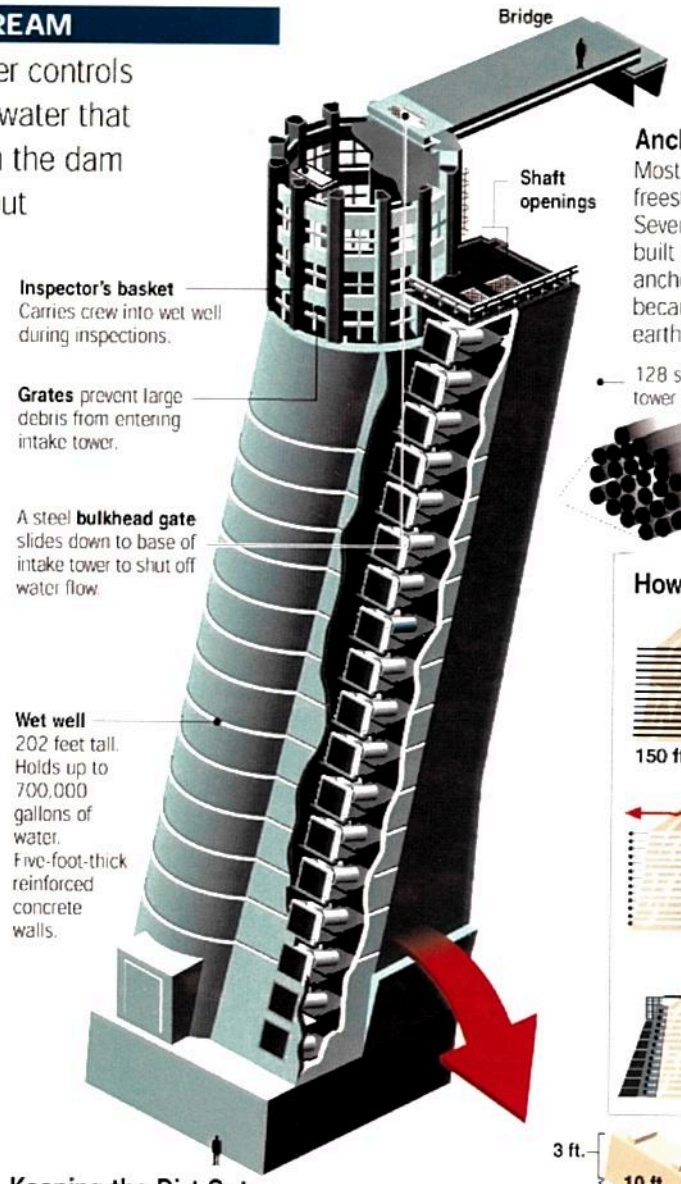
1 Embankment

How Water Goes Through the Dam

1. **Embankment** stops water.
2. Water rises to **intake tower.**
3. Intake tower guides water into **outlet tunnel.**
4. **Gate chamber** controls water flow.
5. Water force dissipates in **plunge pool** beforextra elling down river.

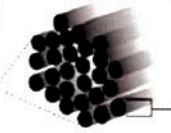
FROM UPSTREAM

The intake tower controls the amount of water that passes through the dam while filtering out sediment.



Anchoring

Most intake structures are freestanding and rectangular Seven Oaks' intake structure was built as an angled tower and is anchored to the mountain because of the area's high earthquake potential.

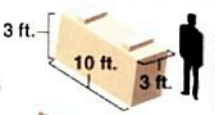


How Tower Is Anchored

1 Holes are drilled deep into mountain, **anchors** inserted. Deepest 10 feet of anchors are held in place with grout.

2 After grout sets, hydraulic jacks pull anchors using 100 tons of pressure. **Caps** attached to exposed end. Rest of hole sealed with grout.

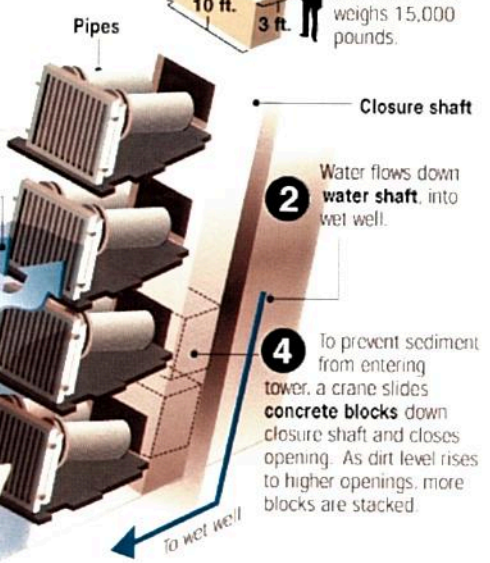
3 Caps are attached to intake tower which leans 15 deg into mountain for added stability.



Concrete block weighs 15,000 pounds.

Keeping the Dirt Out

Tower has two shafts: **closure shaft** stops sediment from entering tower, **water shaft** leads to wet well and outlet tunnel.



1 Water flows into tower through **iron grates**, goes through dual pipes, enters water shaft.

2 Water flows down **water shaft**, into wet well.

3 As water level rises, **sediment** builds up and covers grates.

4 To prevent sediment from entering tower, a crane slides **concrete blocks** down closure shaft and closes opening. As dirt level rises to higher openings, more blocks are stacked.

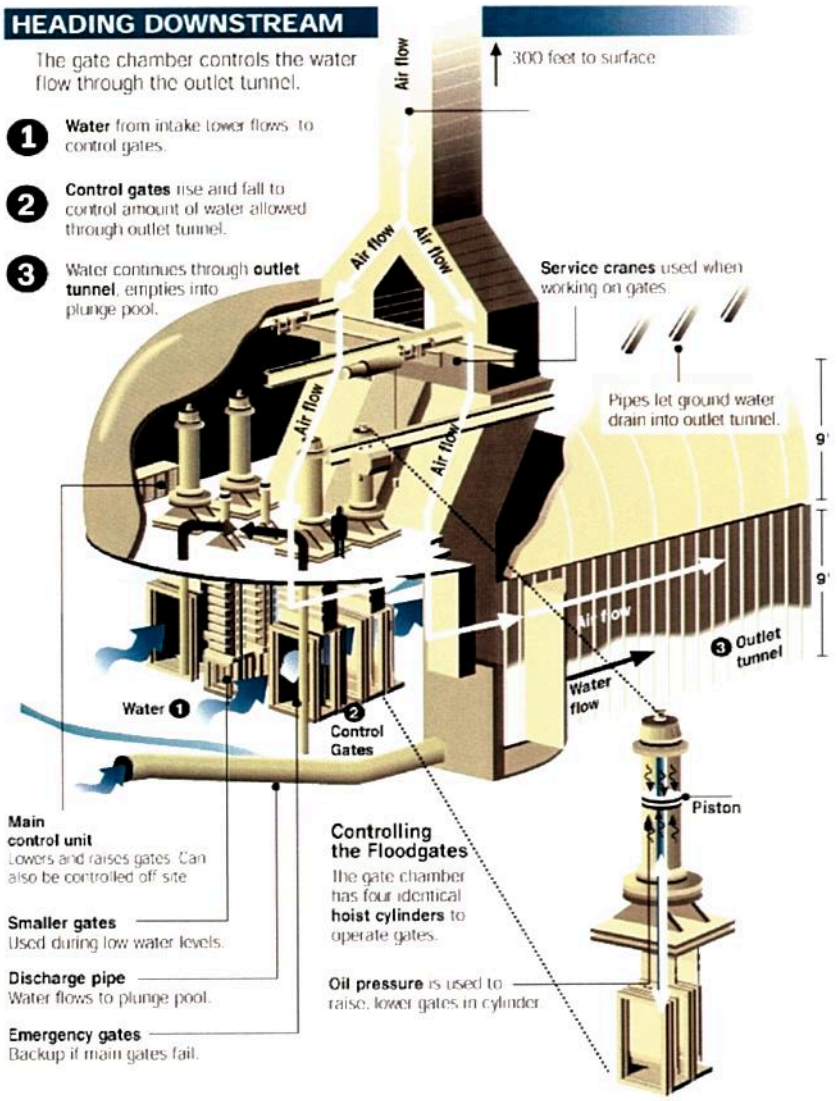
5 Once in wet well, filtered water flows to **outlet tunnel**, which is connected to back of wet well.

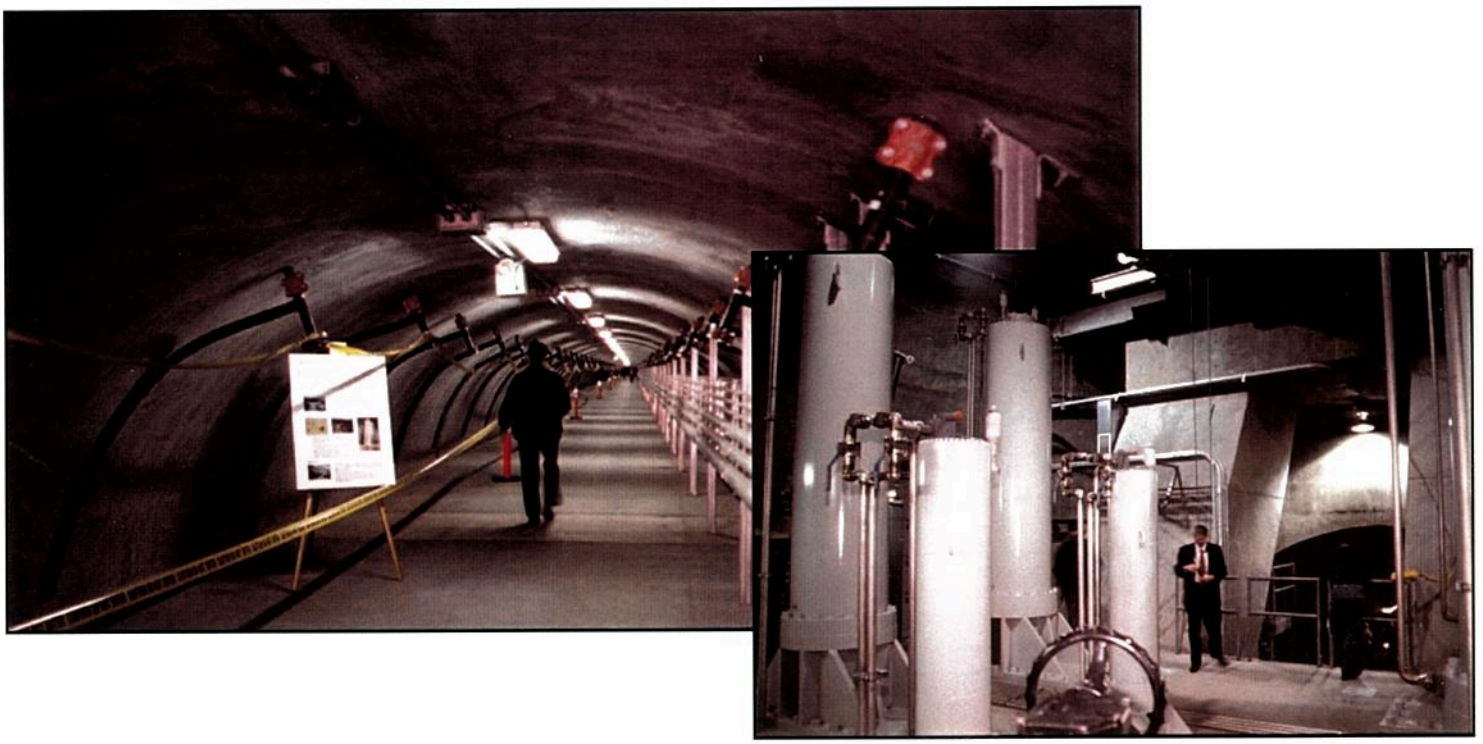
Sources: Odebrecht Group; Orange County Flood Control District; Army Corps of Engineers, Seven Oaks Dam; Los Angeles County Department of Public Works. Photo provided by Orange County Flood Control District

HEADING DOWNSTREAM

The gate chamber controls the water flow through the outlet tunnel.

1. **Water** from intake tower flows to control gates.
2. **Control gates** rise and fall to control amount of water allowed through outlet tunnel.
3. Water continues through **outlet tunnel**, empties into plunge pool.





The view from the top of the Seven Oaks Dam looking downstream.

tion, and the state Occupational Safety and Healthy Department (Cal-OSHA) recognized Odebrecht for its safety achievements in building the dam. On a national scale of 200,000 man-hours, one lost-time accident yields a score of 1.0. The national average for construction accidents is 12.3. The Corps' construction average is 1.07. Odebrecht's average at Seven Oaks was 0.7. This was the first-ever Cal-OSHA safety award to a private contractor.

Huge numbers

Seven Oaks Dam extends across upper Santa Ana Canyon 13 miles east-northeast of San Bernardino, Calif., and 78 miles east of Los Angeles. Rising 550 feet from the floor of the canyon, it is the 12th highest in the nation. With its impermeable clay core and 38 million cubic yards of compacted earth and rockfill, it is the 10th largest in volume in the U.S., and 25th biggest in the world.

To build it, the contractor brought in five million cubic yards of impermeable clay to prevent water penetration. Figuring that each of the huge dumptrucks used on the job carried about 40 cubic yards per trip, that's about 120,000 truckloads.

For strength and stability, permeable rock and soil was added -- 33 million cubic yards of it, enough to fill about 740,000 truckloads. To move that much, Odebrecht used the giant trucks and almost five miles of conveyor-belt systems to haul material from nearby areas.

The dam measures 2,200 feet wide at the base, narrowing to 40 feet at the top. The crest is more than 900 yards long. Behind it, a flood-control reservoir is capable of holding 145,600 acre-feet at the spillway crest. That's 47.5 billion gallons of water.

The spillway, 500 feet wide and 30 feet lower than dam's crest, will direct floodwaters down an adjacent canyon and back into the river channel downstream. However, the flood event would have to be a 350 year event to flow over the spillway Should the dam have to open its gates, the water would race through the outlet works in an 18-foot conduit at around 100 miles an hour for 1,656 feet before shooting into a downstream plunge pool to dissipate its energy.

High stakes

Orange County with its large flood plain will benefit

Guests viewed the big display of the progress of Seven Oaks Dam construction from the groundbreaking ceremony to the topping off ceremony.

the most from the dam, but portions of San Bernardino and Riverside counties are now also protected. But the stakes are higher now than before World War II. In the river's flood plain there are now thousands of homes and businesses. Damage from a major flood could reach $15 billion.

Just one part

Seven Oaks Dam is a major work, but it is just one part of the Corps' Santa Ana River Mainstem Project. The river from its headwaters in the San Bernardino Mountains to its mouth at the Pacific Ocean runs just 75 miles, but passes through nine heavily-urbanized cities with valuable residential and commercial development. In semi-arid southern California, where droughts are not uncommon, residents may not think much about a flood. In fact, though, the Santa Ana River poses the greatest flood threat west of the Mississippi River.

The 1938 flood was the region's worst in the 20th century. It overspread the entire northern half of Orange County. Nearly all bridges were destroyed, and there were damages to agricultural lands -- lands that are now urbanized. Rapid growth in Southern California has decreased the effectiveness of the existing flood-control system, because areas that would once have absorbed rainfall runoff have been reduced by widespread development.

Today, without Seven Oaks, flooding could exceed the present capacity of the Corps' Prado Dam 35 miles downstream, breach levees, and spread over 110,000 acres. Transportation corridors would be heavily impacted, and traffic halted on six major freeways as well as railroad lines. Major public facilities would be inundated -- hospitals, sanitation plants, hotels, shopping centers, universities and community colleges, sports arenas, and important economic venues such Disneyland and Knotts Berry Farm.

The Santa Ana River Mainstem Flood Control Project is expected to relieve downstream homes and businesses from flood insurance. A decision on whether to lift that requirement could be made by the Federal Emergency Management Agency in the next few months. There are several items remaining before the entire project is scheduled for completion by 2006. The lower Santa Ana River Reach 9 (Reach 8 will be completed this year), Santiago Creek, San Timoteo Creek Reach 3B and landscaping along the river. Prado Dam was extracted from the project and will be funded by Congress separately.

The Los Angeles District Newscastle

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