

552

RECEIVED
FEB 28 1990
OFF No. 100-1018

United States Department of the Interior
National Park Service

National Register of Historic Places
Registration Form

DIVISION OF
NATIONAL REGISTER PROGRAMS
NATIONAL PARK SERVICE

This form is for use in nominating or requesting determinations of eligibility for individual properties or districts. See instructions in *Guidelines for Completing National Register Forms* (National Register Bulletin 16). Complete each item by marking "x" in the appropriate box or by entering the requested information. If an item does not apply to the property being documented, enter "N/A" for "not applicable." For functions, styles, materials, and areas of significance, enter only the categories and subcategories listed in the instructions. For additional space use continuation sheets (Form 10-900a). Type all entries.

1. Name of Property

historic name Alcantarilla Pluvial sobre la Quebrada Manzanares
other names/site number Los Tuneles de San Germán; Vaulted Brick Tunnel Storm-Sewer System

2. Location

street & number Calle Ferrocarril and Calle Esperanza not for publication
city, town San Germán vicinity
state Puerto Rico code PR county San Germán code PR 125 zip code 00753

3. Classification

Ownership of Property	Category of Property	Number of Resources within Property	
<input type="checkbox"/> private	<input type="checkbox"/> building(s)	Contributing	Noncontributing
<input checked="" type="checkbox"/> public-local	<input type="checkbox"/> district	<u>0</u>	<u>0</u> buildings
<input type="checkbox"/> public-State	<input type="checkbox"/> site	<u>0</u>	<u>0</u> sites
<input type="checkbox"/> public-Federal	<input checked="" type="checkbox"/> structure	<u>1</u>	<u>0</u> structures
	<input type="checkbox"/> object	<u>0</u>	<u>0</u> objects
		<u>1</u>	<u>0</u> Total

Name of related multiple property listing: _____
Number of contributing resources previously listed in the National Register 0

4. State/Federal Agency Certification

As the designated authority under the National Historic Preservation Act of 1966, as amended, I hereby certify that this nomination request for determination of eligibility meets the documentation standards for registering properties in the National Register of Historic Places and meets the procedural and professional requirements set forth in 36 CFR Part 80. In my opinion, the property meets does not meet the National Register criteria. See continuation sheet.
Mariano G. Coronas Castro February 26, 1990
Signature of certifying official Date
State Historic Preservation Officer
State or Federal agency and bureau

In my opinion, the property meets does not meet the National Register criteria. See continuation sheet.
Signature of commenting or other official _____ Date _____
State or Federal agency and bureau _____

5. National Park Service Certification

I, hereby, certify that this property is:
 entered in the National Register. Amy Federman 4/12/90
 See continuation sheet. _____
 determined eligible for the National Register. See continuation sheet. _____
 determined not eligible for the National Register. _____
 removed from the National Register. _____
 other, (explain:) _____
Signature of the Keeper Date of Action

6. Function or Use

Historic Functions (enter categories from instructions)

Government: Public Works
Transportation: Pedestrian-related
Transportation: Rail-related

Current Functions (enter categories from instructions)

Government: Public Works

7. Description

Architectural Classification

(enter categories from instructions)

No style

Materials (enter categories from instructions)

foundation Rubble

walls Rubble

Brick

roof Brick

other Concrete

Describe present and historic physical appearance.

GENERAL PHYSICAL CHARACTERISTICS

The main part of the San Germán vaulted brick tunnel storm sewer system covers the underground course of Quebrada Manzanares from its headwaters to its resurgence as a surface stream, 842.53 meters away, measured along the stream-bed. The general course of this tunnel is shown on the Site Plan provided on Continuation Sheet 10:2).

The main tunnel resulted from the haphazard covering of Quebrada Manzanares by individual property owners and street culverts between c.1835 and c.1911, as its banks became urbanized.

The typical section of the main tunnel has rubble-masonry walls, a concrete floor with a gentle slope to its center and a barrel-vault either recessed or flush with the walls, which is 1/2, 1 1/2 or 2 bricks thick (see accompanying Continuation Sheet 7:8). Widths of the main tunnel range from 36 inches to 148 inches, and heights from 38 inches to 117 inches.

The maximum dimensions do not occur at or near the point of discharge, but at isolated intermediate points. In general, tunnel sections originally built as street culverts and bridges are higher and wider than tunnel sections located beneath city blocks. This is due to the fact that while the roadbeds are raised above grade, building foundations, basements and sunken yards reach several feet below grade.

Drainage structures built to conduct storm water into Quebrada Manzanares were being built as early as the 1860's. Quebrada Manzanares receives storm waters from roofs, yards, parking lots and streets through drains, pipes and through relatively small vaulted brick branches at dozens of points along its underground course.

The vaulted brick branches, most of them abandoned and sealed, date mostly from before 1910. A good number of these vaulted branches were probably for conveying raw sewage from properties less than three blocks away before the sanitary sewer was built in San Germán around 1935; a few of them still do.

Quebrada Manzanares is still joined at a few points by other permanent streams flowing through smaller vaulted tunnels or pipes.

See continuation sheet

8. Statement of Significance

Certifying official has considered the significance of this property in relation to other properties:

nationally statewide locally

Applicable National Register Criteria A B C D

Criteria Considerations (Exceptions) A B C D E F G

Areas of Significance (enter categories from instructions)
Community Planning & Development
Engineering

Period of Significance
c.1835 - c.1918

Significant Dates
c.1835
1918

Cultural Affiliation
N/A

Significant Person
N/A

Architect/Builder
various

State significance of property, and justify criteria, criteria considerations, and areas and periods of significance noted above.

The city of San Germán occupies its present site since 1573. The older part of the City sits on a foothill overlooking a bend of the Guanajibo River, a normally placid, shallow, westerly flowing stream which has carved a flat, pluvial valley between two mountain ranges. The San Germán foothill belongs to the east-west range immediately south of the urban core.

Several year-round springs flow north from this mountain range, forming streams (quebradas) which join the Guanajibo River. The mountain just behind the City is called Ancones. The springs south of the San Germán foothill flow down the north slope of this mountain, turn east until rounding the San Germán foothill, then flow north again until discharging into the river. Of these streams, the most westerly is Quebrada Manzanares. During heavy rains, stormwater flowing down the rather steep slopes immediately south of the urban area of San Germán join Quebrada Manzanares, augmenting its flow from trickle to torrent.

Up to the mid-1800's, the east-west course of Quebrada Manzanares served as a southern boundary for the urban area of San Germán. The lands just south of the stream belonged to the city government as common land (érido común). To the north of the stream there were privately-owned plots of land, most of them vacant. The road entering San Germán from the west became Calle Luna. Upon approaching the urban area, the road passed through the érido común, keeping a safe distance from Quebrada Manzanares. At the eastern edge of the city, Quebrada Manzanares turned north across Crown lands belonging to the Santo Domingo Convent (Porta Coeli Chapel, built in 1609, NRHP: 09/08/76) enroute to the Guanajibo River.

Quebrada Manzanares presented problems to the growing town. Its channel, 6 to 12 feet deep and 4 to 10 feet wide, was considered dangerous, especially near homes and streets. During heavy rainstorms, its lower, northerly course flooded Calle Javilla and its vicinity (see accompanying Site Plan on Continuation Sheet 10:2). During the latter part of the 19th century, it became polluted with human and animal wastes.

See continuation sheet

9. Major Bibliographical References

Pumarada O'Neill, Luis and Miguel Cruz Arocho. "Study and Recommendations on the San Germán Vaulted Brick Tunnel Storm-Sewer System." Final Technical Report to the U.S. Department of the Interior, July, 1988.

Archivo General de Puerto Rico; Fondo de Obras Públicas; San Germán.

Previous documentation on file (NPS):

- preliminary determination of individual listing (36 CFR 67) has been requested
- previously listed in the National Register
- previously determined eligible by the National Register
- designated a National Historic Landmark
- recorded by Historic American Buildings Survey # _____
- recorded by Historic American Engineering Record # _____

See continuation sheet

Primary location of additional data:

- State historic preservation office
- Other State agency
- Federal agency
- Local government
- University
- Other

Specify repository:

Water Resources Research Institute;
Mayagüez Campus, UPR.

10. Geographical Data

Acreege of property less than one-half acre

UTM References

A
 Zone Easting Northing

C

B
 Zone Easting Northing

D

See continuation sheet

Verbal Boundary Description

The boundaries of the 842.53m long Quebrada Manzanares Storm-Sewer System are represented in the accompanying "Detailed Site Plan" and interior plan and profile views.

See continuation sheet

Boundary Justification

The boundaries are limited to the occupied area of construction and the volume encompassed by the same. Only tunnel sections built up to 1918 are being nominated.

See continuation sheet

11. Form Prepared By

name/title Héctor Santiago-Architectural Historian/Luis Pumarada-Historical Eng.

organization Puerto Rico SHPO date _____

street & number Calle San José 109 telephone 809-721-3737

city or town San Juan state Puerto Rico zip code 00901

**United States Department of the Interior
National Park Service****National Register of Historic Places
Continuation Sheet**

Section number 7 Page 1 Vaulted Brick Tunnel Storm-Sewer System,
San Germán, Puerto Rico

GENERAL ROUTE OF THE MAIN TUNNEL

The upper part of the Quebrada Manzanares tunnel follows a generally northerly direction down the slope of Ancones Mountain, keeping generally parallel to Calle Esperanza, which it crosses about halfway down. This part of the tunnel averages 38 inches wide and 44 inches high near the top, 48 inches wide and 64 inches high just south of Calle Luna, and 48 inches high and 63 inches wide below this same street.

After a sharp turn, Quebrada Manzanares runs generally east along the bottom of a valley, nearly parallel and to the north of Calle Luna. This gently-sloping second part of the tunnel varies frequently and sometimes sharply in cross-section: it is 148 inches wide and 117 high just west of Calle Cruz; 73 inches wide and 40 inches high east of Calle Ramas.

Past the eastern slope of the hill crowned by Porta Coeli Chapel, the Quebrada Manzanares valley joins the Guanajibo River valley, and the tunnel again turns north. This third part of the tunnel is rather recent, it consists of a gently sloping rectangular concrete culvert, 63 inches wide and ranging in height from 81 inches under Calle Javilla to about 50 inches at the outlet. The culvert's roof slab serves as a sidewalk for Calle Vivoni and, farther on, as a narrow access road to properties located north of the Vivoni housing development. From the end of this culvert on, Quebrada Manzanares continues as a surface stream, joining the Guanajibo River about 200 meters north of the mouth of the tunnel.

DETAILED DESCRIPTION OF THE TUNNEL

Ancones to Calle Luna:

One may enter the upper end of the Quebrada Manzanares vaulted brick tunnel system through a storm water inlet trench at Calle Ferrocarril, about 6 meters west of Calle Esperanza.

A six-foot drop through the trench drain leads into a vaulted brick tunnel with a concrete floor. The clear but contaminated one inch-deep water flows rather swiftly along its center due to the sharp slope.

The tunnel actually begins 13 meters south (upstream) of this access, at a storm water manhole which receives spring and storm waters from farther south through a rectangular concrete culvert, and from east and west through concrete pipes. The southernmost 12 meters of brick vault were built circa 1892 by the Compañía Ferrocarrilera de Puerto Rico, a French company licensed in 1888 to build and operate a railroad which was to circle the island. This structure, with cut-stone walls and a brick vault (Photo 1) allowed Quebrada Manzanares to flow under the railbed; it is typical of other railroad drainage structures remaining in the area.

United States Department of the Interior
National Park ServiceNational Register of Historic Places
Continuation SheetSection number 7 Page 2 Vaulted Brick Tunnel Storm-Sewer System,
San Germán, Puerto Rico

The segment under Calle Ferrocarril, with its brick vault resting on plastered walls (made of either brick or rubble-and-lime mortar) was probably built between 1892 and 1910. It leads into a rectangular concrete section, only 36 inches high (Photo 2), which crosses under the property located at the northwest corner of Calle Ferrocarril and Calle Esperanza. The rectangular construction ends at a serious constriction caused by a foundation column which projects halfway into the tunnel (Photo 3). A higher, vaulted section, also in concrete, follows. Upon reaching Calle Central the Quebrada Manzanares tunnel turns slightly east. The concrete segment under this street, which has a recessed vault, dates from 1911. So does the vaulted concrete segment to the north which crosses under a block-long property with a circa 1911 sculptured concrete block home to reach the Calle Tetuán vaulted brick culvert.

These uncomfortably low, sharply-sloping vaulted concrete segments are nearly uniform in width. There are small patches of floor damage along their edges, and a long, deep gash in the center of the tunnel just south of Calle Tetuán. There are several changes in construction details, corroborating the records documenting that these segments were destroyed and rebuilt twice. Several horizontal concrete inlets convey storm water into the tunnel from the west.

The Calle Tetuán culvert, made in brick, is older and much taller than the concrete segments which lead down to it (Photo 4).

The Tetuán culvert, which probably dates from circa 1895, is similar to the Calle Ferrocarril culvert in that both have horizontal vaults and sloping floors, but the Tetuán vault, unlike Ferrocarril's is recessed, and has a steeper floor slope.

Beyond a relatively large hole in the floor of this culvert, a nearly uniform segment with a recessed, lower concrete vault runs beneath the western edge of three small properties facing Calle Esperanza, as if Quebrada Manzanares had been their western boundary. This segment ends just under the southern edge of the south sidewalk of Calle Sol.

A steel plate atop a gutter inlet at the south side of Calle Sol covers a narrow vertical 12-foot drop into the Sol/Esperanza vaulted brick culvert. A corbelled brick storm water inlet flares down (Photo 5) into this culvert, which dates from before 1872. This straight, uniform recessed vault segment starts beneath the edge of the Calle Sol sidewalk, and heads northeast, cutting diagonally across both streets. It passes under the property on the northwest corner. A second corbelled brick inlet connects to a gutter drain on the north side of Calle Sol, about two meters west of this corner, and a third such inlet connects to a gutter drain at the east side of Calle Esperanza but neither of these inlets allows access to the tunnel system.

United States Department of the Interior
National Park ServiceNational Register of Historic Places
Continuation SheetSection number 7 Page 3 Vaulted Brick Tunnel Storm-Sewer System,
San Germán, Puerto Rico

Northeast of Calle Esperanza, the tunnel is also made of brick and has a recessed vault, but it becomes slightly narrower and turns almost due east, then north-northeast, then east-northeast, then northeast, approximately coinciding with property divisions east of Calle Esperanza (see accompanying Site Plan on Continuation Sheet 10:2). A waste water pipe discharging on the west side is guarded by a cohort of cockroaches. These segments have uniform width and recessed vaults, but slight changes in height and some structural discontinuities indicate that there may have been more than one builder involved, probably between 1885 and 1895. The west wall and the vault near the lower end of the section oriented to the northeast shows extensive and unsightly repairwork, done in concrete with corrugated iron sheets (Photo 6).

Upon approaching Calle Luna from the south, the floor slope decreases. The segment just downstream of the repair patch mentioned above, is lacking the floor slab because of channel erosion for the next 20 feet, and Quebrada Manzanares drops about 12 inches down into a sizeable waterhole which is about 24 inches deep.

Just above the center of this waterhole there is a vertical access through a 24-inch square patio drain which is covered with an iron bar grille and a piece of plywood. This access is located in the backyard of a structure located west of the parking lot of the Presbyterian Church, south of Calle Luna (see Site Plan). Two meters beyond this waterhole, a small permanent stream joins Quebrada Manzanares from beneath the Presbyterian Church parking lot to the east.

This segment ends in a "Y"-shaped chamber, where it is joined by another permanent stream entering through a smaller vaulted brick culvert coming from the north side of Calle Luna (Photos 7 and 8). A drainage trench along the western edge of the Presbyterian Church parking lot discharges into this chamber's vault and the lower vault of the downstream tunnel. This opening is negotiable for access.

Beyond this chamber, the tunnel heads east, gradually approaching Calle Luna. Under the south sidewalk of Calle Luna, the tunnel becomes the vaulted brick culvert which crosses perpendicularly under this street.

The geometry of the two culverts crossing under Calle Luna, corresponds to that of an 1850 sketch (see accompanying Continuation Sheet 7:9). Since no record of subsequent construction or reconstruction was found for any Calle Luna culvert, we assume that both existing culverts were the ones built circa 1851.

Callejón Forés to Calle Javilla:

At the downstream end of the larger, northbound culvert, under the sidewalk of the northeast corner of Calle Luna and Callejón Forés, there is a small chamber with a higher vault and smoothly plastered walls, from which Quebrada Manzanares again turns east.

United States Department of the Interior
National Park ServiceNational Register of Historic Places
Continuation SheetSection number 7 Page 4 Vaulted Brick Tunnel Storm-Sewer System,
San Germán, Puerto Rico

The first segment of this easterly course of the main tunnel is lined with original stream-bed rocks on both sides for about 5 meters. Beneath the city block between Callejón Forés and Calle Cruz, the tunnel remains straight, gradually diverging northward from Calle Luna. The segment beneath the Hotel Oasis building (formerly the Tomás Fradera home) dates from circa 1860. Its floor slopes down, away from an apparently horizontal vault, increasing the tunnel height from 72 to 117 inches. Under Farmacia Cooperativa drugstore (located in what was the property of the Díaz-Milán sisters in 1872), the tunnel widens to 122 inches (Photo 12). Then it merges into the pre-1835 Calle Cruz vaulted bridge, which spans 148 inches (Photo 13). Two brick drainage structures discharge storm water from Calle Luna and Calle Cruz into this bridge segment. These must be the original structures built in 1867 (see Statement of Significance). The floor of this chamber-sized bridge section shows extensive damage.

The tunnel segment which leaves downstream is only 57 inches high and 48 inches wide. Leaving from the north side of the 144 inch wide end wall of the previous segment, it has the appearance of an opening into a room-- a perception that has baffled many observers, who see a contradiction between the relative size and position of this downstream tunnel segment and the function of a storm sewer system (Photo 13). This segment crosses under a store which was once connected to the commercial building just to its north. Both buildings belonged, around the end of the 19th century, to the same owner. A series of conspicuous and unsightly concrete repair patches and some embedded stream-bed rocks appear on the north wall of this section (Photo 14). This length of tunnel, with a vaulted roof which steadily becomes higher as the floor slopes down, ends at a northward bend where the vault steps up to a height of 62 inches.

The next segment, located beneath the residential property facing Calle Manzanares which at the turn of the century belonged to merchant Francisco Lagarde, remains 48 inches wide, but has a recessed vault. This vault is only 1/2 brick thick. Just east of the bend there is a corbelled brick vertical inlet, to the top of which there is connected a 4-inch diameter vertical pipe which may be a roof drain. This inlet is similar to, but not as complex as, the ones at the intersection of Calle Esperanza and Calle Sol. This segment ends at a slight bend, on a diagonal-projecting arch, beyond which the tunnel steps up in height from 72 to 112 inches and in width from 50 to 86 inches (Photo 15).

This ample segment is lined with stream-bed rocks (Photo 16). Similar rocks were said to have been once dislodged and carried downstream by flood waters. They had to be eventually crushed in-situ, since it was impossible to move them and they could not be permitted to remain blocking the stream. This segment gradually narrows down just beyond the rocks to a height of 85 inches and a width of 65 inches. This tunnel segment, the ones following it down to Calle Carro, and the one just beyond its street culvert, were

United States Department of the Interior
National Park ServiceNational Register of Historic Places
Continuation SheetSection number 7 Page 5 Vaulted Brick Tunnel Storm-Sewer System,
San Germán, Puerto Rico

built by merchant Francisco Lagarde between circa 1895 and circa 1910, as he expanded his flourishing business. The Lagarde building once above this segment has made way to a parking lot.

The next segment runs under an old Lagarde storehouse, of which, due to recent demolition only three facades remain. This segment has an access opening, 30 X 36 inches, framed in iron (Photo 17), used for the maintenance of the tunnel segments belonging to Francisco Lagarde. The frame held a trap door. This access lies just west of a former, sunken patio which was accessible from a service ramp, entering from Calle Luna, prior to the aforementioned demolition.

As the Lagarde basements above became deeper, the vaulted roof stepped successively lower: as little as 45 inches in height downstream of the access door. There is evidence of raw sewage discharge in this section. Beyond, the tunnel grows slightly in size before having a minor constriction provided with end walls, after which the tunnel opens into a space 75 inches wide and 94 inches high. This taller space lies under the eastern part of the old Lagarde building, which has no basement or sunken patios.

This tall segment merges into the Calle Carro culvert, which dates from 1853 (see accompanying Continuation Sheet 7:10). The Calle Carro culvert's vault shows a dangerous crack across, and its floor is significantly damaged. It is joined from the north side, above vault level, by a horizontal vaulted brick branch which runs beneath Calle Carro, close to the west curb gutter. There is seepage of waste water between vault bricks which may originate from a sewage pipe crossing above the vault. The culvert, which becomes 115 inches high and 76 inches wide, ends with its vault dropping 30 inches and with a constriction caused by the southern wall, just where it is joined by a horizontal vaulted brick storm water branch with a dangerous, extensively damaged floor.

In the segment following the Calle Carro culvert, there is a vertical brick inlet with a hinged brick access door. Just beyond this feature, the vault has been replaced by a concrete slab for a length of about 7 feet. This segment was also built by Francisco Lagarde circa 1905.

East of this slab roof, the tunnel averages just over 80 inches in height. It is characterized by slight misalignments and small variations in vault height. In the section west of the Calle Alfonso XII culvert, the tunnel height is reduced to 72 inches. We believe that Ramón Acosta had his home above this section, and that therefore, this part dates from before 1872. Upon reaching the circa 1865 Calle Alfonso XII culvert, the southern wall flares out and the vault steps up, creating a space which is 110 inches high and 92 inches wide. This culvert has direct openings to curb drains on the street above. Its upstream end shows structural damage on the vault.

United States Department of the Interior
National Park ServiceNational Register of Historic Places
Continuation SheetSection number 7 Page 6 Vaulted Brick Tunnel Storm-Sewer System,
San Germán, Puerto Rico

A horizontal vaulted brick branch, about 58 inches high, brings the permanent waters of Quebrada Antongiorgi from the south to join those of Quebrada Manzanares within this culvert (Photo 18). This branch, which runs under the west side of Calle Alfonso XII, collapsed about 10 years ago, interrupting traffic for several months. The collapsed length, and the contiguous part crossing under Calle Luna were replaced by a 48-inch diameter concrete pipe. This stream comes down from beyond an old railroad culvert within the Antongiorgi property; it enters a rectangular concrete conduit which conveys it into the circa 1860 vaulted brick culvert about 7 feet south of Calle Luna. There is extensive, dangerous floor damage in this important branch just beyond the downstream end of the concrete piping (Photo 19). A street drain on the northwest corner of the intersection of Calle Luna and Calle Alfonso XII provides access to this branch and, through it, to the main tunnel.

At the east end of this culvert, the height of the vaulted roof comes down from 112 to 83 inches. In the tunnel segment beyond, underneath what was the property of Santiago Rivera, the floor slopes down relative to the roof, increasing the vault height to 102 inches at its east end. At this point, the north wall steps in to reduce the tunnel width from 83 to 58 inches. This constriction appears to have been modified by the addition of a headwall to improve flood-flow conditions (Photo 20).

The tunnel beyond keeps fairly straight and uniform as it crosses under a property and then runs just south of the line dividing two properties facing Calle Luna from those facing Calle Santiago Veve to the north. Most of its 1/2 brick vaulted roof has been replaced by concrete slabs, and there are instances of floor damage. The top of the vault here is flush with the ground level.

The tunnel again flares out when it becomes the Calle Ramas culvert, a circa 1865 structure. This culvert has inclined, instead of vertical sidewalls (Photo 22). It is 100 inches high and 88 inches maximum width (at the vault recess). A dangerous crack runs across the vault near the upstream end of the culvert (Photo 21).

Just beyond this culvert, the vault drops to a stooping 55-inch height. This circa 1880 segment was probably built by Servera Hermanos, a firm which owned a store and warehouse extending along the east of Calle Ramas, from Calle Luna to Parque de Santo Domingo. It consists of a 2-brick thick barrel vault with no sidewalls (Photo 22). It becomes gradually lower as it passes under the Yamil Galib home, which replaced the Servera store around 1915.

At the end of this low segment, the 47-inch high barrel vault gives way to a narrower tunnel with a concrete slab roof (Photo 23). This rectangular cross-section tunnel which remains about 24 inches clear below grade runs fairly straight and uniform in width, with its height increasing gradually to 84 inches at the next construction discontinuity. It is located

United States Department of the Interior
National Park ServiceNational Register of Historic Places
Continuation SheetSection number 7 Page 7 Vaulted Brick Tunnel Storm-Sewer System,
San Germán, Puerto Rico

just south of the line dividing the properties facing Calle Luna from those facing Calle Santiago Veve to the north. This part, which probably corresponds to the tunnel built by the City circa 1907, receives a polluted flow of permanent water from the south through a vaulted brick branch, as well as some direct raw sewage discharges. Near the end of this segment, the tunnel is joined by a rectangular concrete branch coming from street corner drains at Calle Luna. This branch can be entered from a parking lot on the north side of Calle Luna, across the street corner drains.

Just beyond this branch, the tunnel turns about 60 degrees to cross beneath the property of Sucesión Jaime Acosta, heading towards the intersection of Calle Javilla and Calle Santiago Veve. This segment again has a vaulted brick roof which is about 80 inches high.

Upon reaching the south side of Calle Santiago Veve, the tunnel turns slightly northward to become the culvert crossing under this street's intersection with Calle Javilla. This culvert is similar in height and construction to the preceding section, but 10 inches wider. This circa 1860 structure marks the end point of the original vaulted brick tunnel system.

Concrete Addition:

The Calle Javilla culvert has been extended in a rectangular concrete construction to the east side of Calle Vivoni (Photo 24). There it turns slightly northward, and its concrete roof slab becomes the east sidewalk along that street. At the entrance to the San Germán Health Centre, Calle Vivoni turns east and the tunnel crosses to continue between this facility and the Ensanche Vivoni development, with its concrete slab roof now serving as a roadway. This segment dates from 1950.

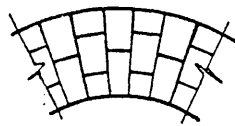
The tunnel ends just beyond the health centre property limits. It discharges a 36-inch high waterfall into a waterhole. Thus, Quebrada Manzanares becomes a surface stream until it reaches the Guanajibo River, about 200 meters to the north.

*The above description has been adapted from Pumarada O'Neill and Cruz Arocho, 1988, with only minor revisions.

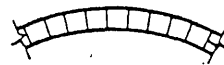
United States Department of the Interior
National Park Service

National Register of Historic Places Continuation Sheet

Section number 7 Page 8 Vaulted Brick Tunnel Storm-Sewer System,
San Germán, Puerto Rico

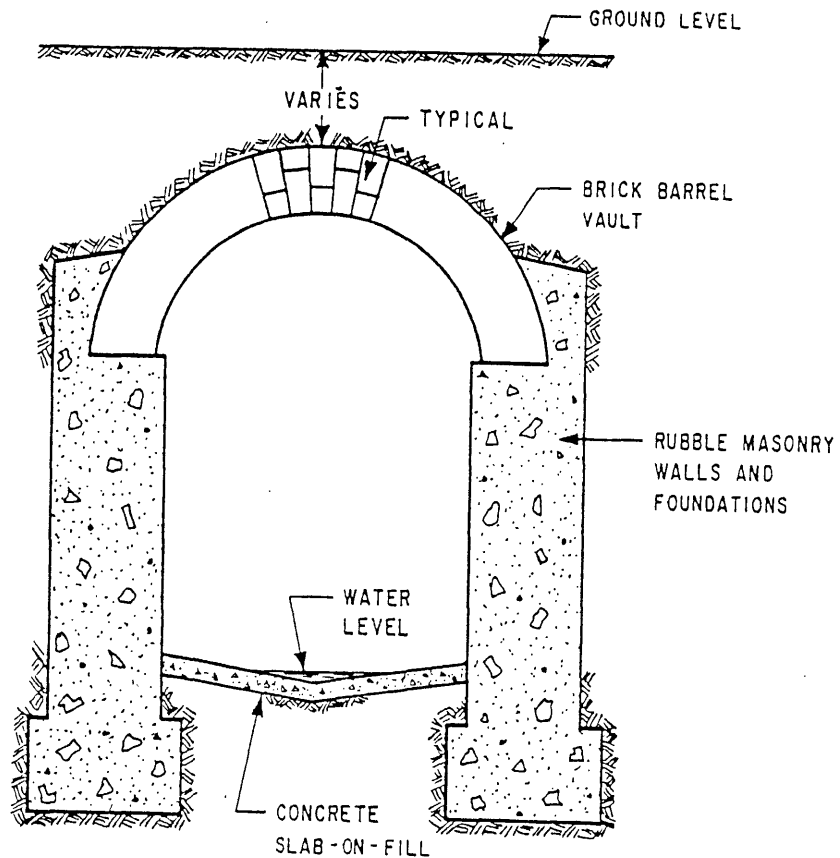


2 BRICKS THICK



1/2 BRICK THICK

PARTIAL VAULT SECTIONS

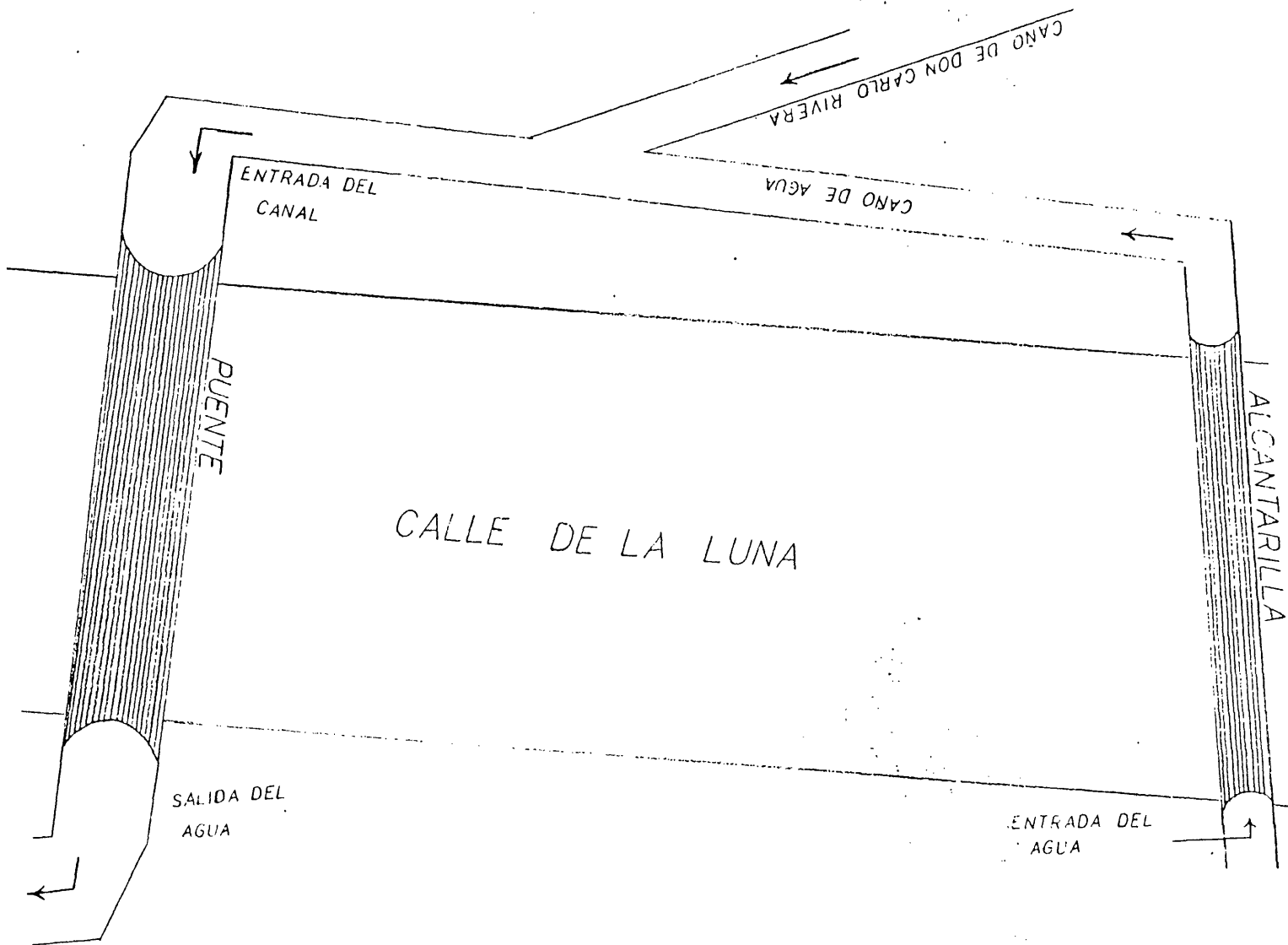


SECTION OF TYPICAL 1/2 BRICK THICK
RECESSED TUNNEL SEGMENT VAULT

United States Department of the Interior
National Park Service

National Register of Historic Places Continuation Sheet

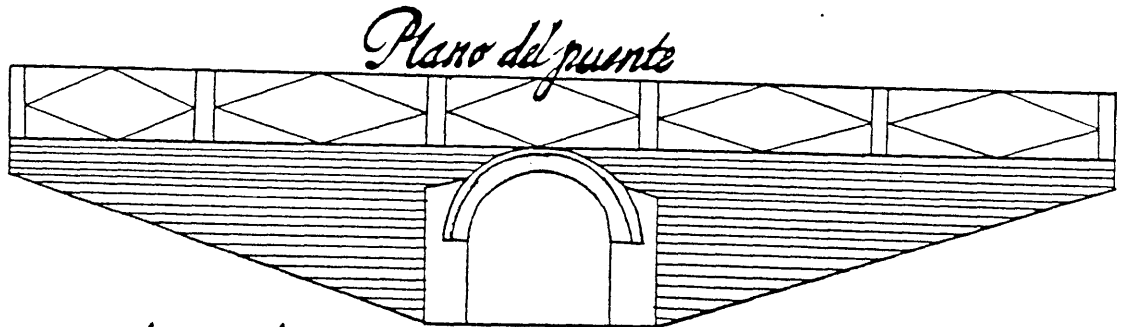
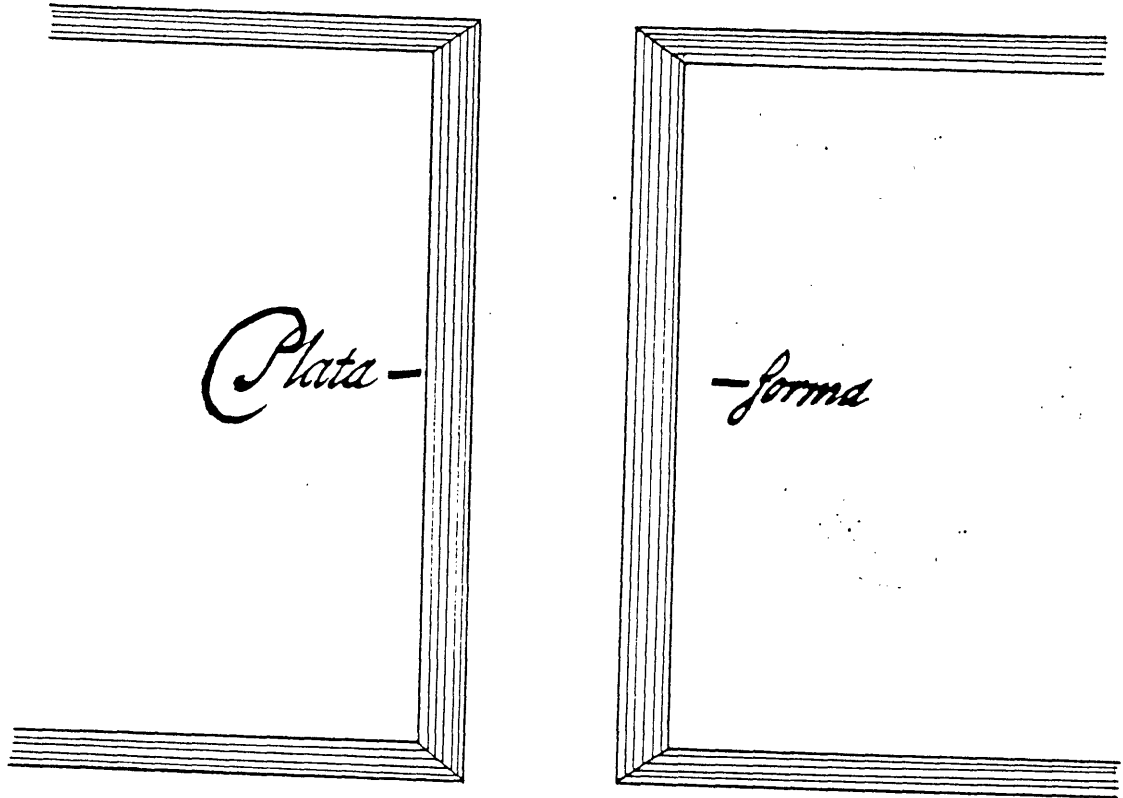
Section number 7 Page 9 Vaulted Brick Tunnel Storm-Sewer System,
San Germán, Puerto Rico



United States Department of the Interior
National Park Service

National Register of Historic Places
Continuation Sheet

Section number 7 Page 10 Vaulted Brick Tunnel Storm-Sewer System,
San Germán, Puerto Rico



1/2 ladrillo la boluda -

1. 2. 3. 4. 5. 6. 7. 8. 9. 10. 11. 12. 13. 14. 15. 16. 17. 18. 19. 20.

Escala -

United States Department of the Interior
National Park ServiceNational Register of Historic Places
Continuation SheetSection number 8 Page 1 Vaulted Brick Tunnel Storm-Sewer System,
San Germán, Puerto Rico

Toward the second quarter of the 19th century, a great influx of Spanish, other European, and Latin-American immigrants, intimately related to Spain's loss of all other American territories other than Cuba and Puerto Rico, spurred unprecedented population increases and consequently, proportional urban growth in San Germán and other areas of the Island. Up to around that period, San Germán's urban area was limited to the blocks immediately adjacent-to or surrounding the Plaza del Mercado (now known as the Plaza de Mariano Quiñones) and the Plaza de Santo Domingo. The new growth implied the westerly and southerly expansion of the urban core, over the natural border created by the Quebrada Manzanares.

A masonry-arch bridge was thus constructed over the Quebrada Manzanares along Calle Cruz, the main road leading south toward Ancones and the out-lying village now known as the Town of Lajas. In addition to providing an adequate crossing for the Quebrada Manzanares, the bridge at Calle Cruz, built prior to 1835, became the first covered segment of what is now the vaulted brick storm-sewer system. Quebrada Manzanares was subsequently covered over by segments in a haphazard manner from its waterhead to the Calle Javilla crossing by means of brick and concrete vaults over a period of approximately 75 years. This continuous construction process facilitated the much-needed expansion of San Germán toward the south, into the area which shortly afterward was occupied by Calle Luna, currently the City's main thoroughfare.

Also around 1835, Pascual Antongiorgi, a large sugar producer, builder and businessman who owned a house which bordered on the old bridge, expanded the bridge about two meters behind his land in order to protect his property from flooding waters. Antongiorgi also appears on a historical document as the builder or contractor conducting repairwork on damage caused by the overflowing of Quebrada Manzanares at Calle Comercio (now Calle Santiago Veve) in 1846. We infer from this document that a culvert already existed at the intersection of this street with Calle Javilla. A vaulted brick culvert was also erected at the crossing of Calle Luna in 1851. Another culvert over the stream was built at Calle Carro in 1853.

The township considered the stream-bed to be in the public domain and sometimes negotiated permits requested by adjacent property owners to cover the stream and utilize the space above it. In 1858, it was reported that some citizens favored covering all of the urban part of Quebrada Manzanares for flood control, safety, and public health reasons, claiming that the city should take the economic and administrative responsibility for covering it. The Municipal Council argued that adjacent property owners were actually covering the stream segment by segment and that, with time, the whole urban area of the stream would have been covered over as a result. In the meanwhile, the lands between Calle Luna and Quebrada Manzanares were being granted and/or sold to citizens for residential and commercial development. These lands were exclusively segregated for citizens of elevated social or economic status, according to local traditions and Municipal Ordinances dating from 1736, thus assuring the eventual completion of the system as well.

United States Department of the Interior
National Park ServiceNational Register of Historic Places
Continuation SheetSection number 8 Page 2 Vaulted Brick Tunnel Storm-Sewer System,
San Germán, Puerto Rico

As early as 1867, stormwater inlets were being built at the southern corners of Calle Luna and Calle Cruz to collect and conduct this water under Calle Luna and into the Quebrada Manzanares. This began the conversion of Quebrada Manzanares into a drainage system, augmenting its average flow even more and increasing the necessity to cover the remaining urban segments of the natural stream.

In 1888, the city council considered a proposal to utilize the Quebrada Manzanares system as a main tunnel for the city's first waste-water sewer. No documentation has been found to prove that this system was built, but the Quebrada Manzanares did eventually become the waste sewer of the town as well, since it is clear that some neighboring property owners built small, vaulted, brick waste drains leading into the stream. This spontaneous action further aggravated the need to cover the entire stream for public health purposes.

By 1872, bridges or culverts existed for the following street crossings: Calle Cruz, Calle Luna, Calle Carro, Calle Principe Alfonso (Alfonso XII), Calle Ramas, Calle Esperanza and Calle Javilla at its junction with Calle Comercio (Santiago Veve). All of these structures were built by the Municipality, except for the Calle Esperanza culvert. This culvert, as well as numerous additional vaulted segments were built by individual landowners in the interest of protecting their properties from flooding and eventually building over the stream.

The railroad passing south of San Germán was under construction in 1892. It crossed Quebrada Manzanares just north of Fuente San Luis, and a culvert consisting of a brick vault upon stone walls was built for this purpose. A similar culvert was built for the stream crossing the Antongiorgi property, to the east of the San Luis spring.

By c.1910, Quebrada Manzanares was covered at the following places: just beyond its headwaters by the culvert under the railroad tracks which had been extended north beneath the adjacent Calle Ferrocarril; from about Calle Central to the north and east beyond the crossing under the corner of Calle Esperanza with Calle Tetuán; at the crossing under Calle Luna; under the house of Ulises López Carlo (formerly of Tomás Fradera); at the crossing of Calle Cruz, continuing under the properties of Ramón A. Torres and Francisco Lagarde and the Calle Carro crossing; through to the Calle Alfonso XII crossing to the house of Santiago Rivera on the northeast corner of that street with Calle Luna; at the Calle Ramas crossing and under the Servera store (currently the site of the Yamil Galib House, determined eligible, 07-14-86); and finally, at the Calle Javilla crossing.

In 1911, a segment of concrete tunnel extending 23 meters south of Calle Tetuán was built by master builder Sebastián Barea for the Municipality, but was partially destroyed by flooding only a few days later. This section, the northernmost part adjoining the brick culvert under Calle Tetuán, was then rebuilt by builder Barón Capriles, and 28 meters of concrete channel

United States Department of the Interior
National Park ServiceNational Register of Historic Places
Continuation SheetSection number 8 Page 3 Vaulted Brick Tunnel Storm-Sewer System,
San Germán, Puerto Rico

were added in order to connect this twice-destroyed length of tunnel to the vaulted culvert already existing under Calle Ferrocarril. Parts of this channel were to be provided with concrete vaults.

The final section of Quebrada Manzanares within the historic urban core of San Germán was covered in 1918 when Jaime Acosta y Fores, owner of a lot on Calle Santiago Veve (Comercio), between Calle Ramas and Calle Javilla, built a brick-masonry vault over the stream in order to build above it his new home (this house was determined eligible for inclusion to the NRHP on 11-19-86, and is currently being nominated for inclusion by the Puerto Rico SHPO).

By 1930, the urban area of San Germán extended well to the south of Calle Luna, facilitated by the then completely-underground drainage system. When land to the north of Calle Santiago Veve was developed by the Vivoni Brothers c. 1950, Quebrada Manzanares had to be covered from that point down for over an additional 100 meters. This was done by means of a rectangular concrete culvert.

A vault failure in 1978 caused an 8-foot diameter hole at the Calle Alfonso XII crossing. a 48-inch diameter concrete pipe was used to replace the caved-in vaulted brick branch conveying the waters from the Antongiorgi stream under Calle Luna and Calle Alfonso XII into the main tunnel. This section, and the c. 1950 concrete section stated above, are not being considered as significant to the historic value of the Quebrada Manzanares drainage system.

The San Germán Vaulted Brick Tunnel Storm-Sewer System's significance in relation to the community's development process begins c. 1935, since this is the earliest date for which the existence of the bridge at Calle Cruz (the first related structure) can be confirmed. In addition, at around this date, the first vaulted extension of this bridge was built, thus commencing the gradual covering of the entire stream-bed. The period of significance extends through to 1918, as this was the date in which the last open segment of Quebrada Manzanares, within the historic urban core, was covered, allowing the urban development of the City of San Germán to completely ignore the existence of the often-dangerous stream. Flood threats within the urban core of San Germán have been virtually eliminated since the completion of the vaulted Quebrada Manzanares drainage system.

The drainage system of San Germán is a living and working testimony as to how the residents painstakingly assumed the task of channeling a stream and creating a sewer system in reaction to the government's lax attitude toward the grave health and public safety problems presented by the Quebrada Manzanares. In addition, the system of tunnels, consisting of road- and rail-related transportation structures, drainage structures, retaining walls, and even building foundations, facilitated, and thus faithfully documents, the City's urban expansion throughout its most significant period of urban growth, from the middle of the XIX century to the first quarter of the XXth.

**United States Department of the Interior
National Park Service**

**National Register of Historic Places
Continuation Sheet**

Section number 8 Page 4 Vaulted Brick Tunnel Storm-Sewer System,
San Germán, Puerto Rico

The drainage system is significant in the field of engineering as well since it displays:

1. the oldest documented bridge within the City of San Germán (pre 1835);
2. a railroad culvert dating from 1892, one of the few remaining and intact railroad-related structures on the entire island;
3. the gamut of popular construction techniques utilized during the approximately 83-year period of construction, ranging from rubble, to brick, to concrete construction and from vaults to slabs; all working together to create a functional flood-control channel as a whole.

Despite the numerous structures which compose the San Germán Vaulted Brick Tunnel Storm-Sewer System, the System is being considered as one significant structure since the resultant drainage system functions as a single entity, and since precise identification of many individual structures and appropriate tallying of the number of structures is impossible due to the many and drastic changes in construction techniques observed within the tunnel and the lack of complete, precise historical documentation.

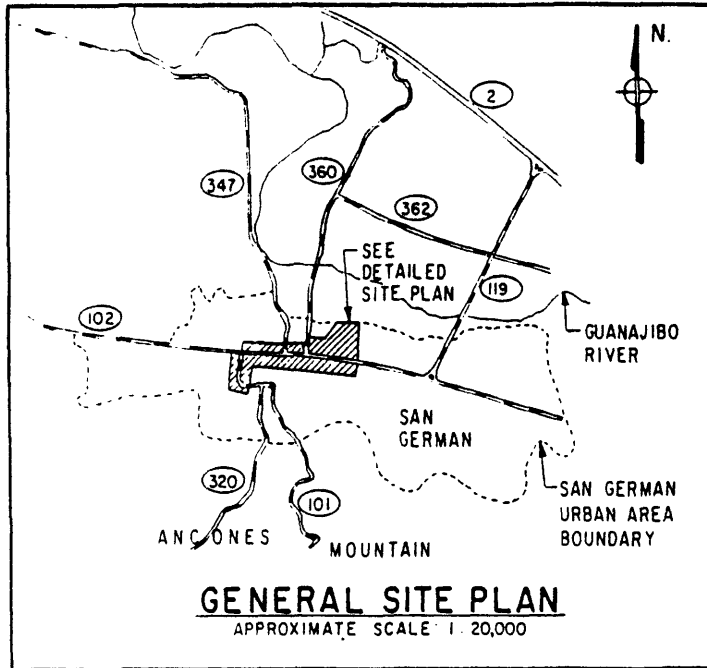
**United States Department of the Interior
National Park Service**

**National Register of Historic Places
Continuation Sheet**

Section number 10 Page 1 Vaulted Brick Tunnel Storm-Sewer System,
San Germán, Puerto Rico

The Universal Transverse Mercator Grid System is not yet available for the San Germán, Puerto Rico quadrangle. The geographic coordinates for the Vaulted Brick Tunnel Storm Sewer System of San Germán, in latitude and longitude, are as follows:

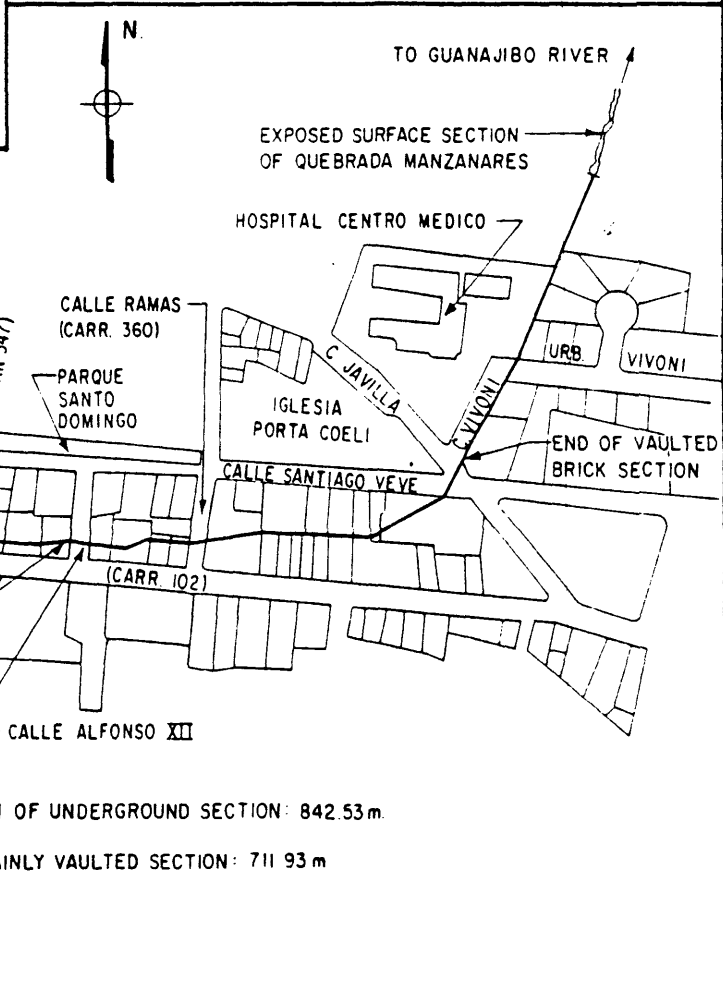
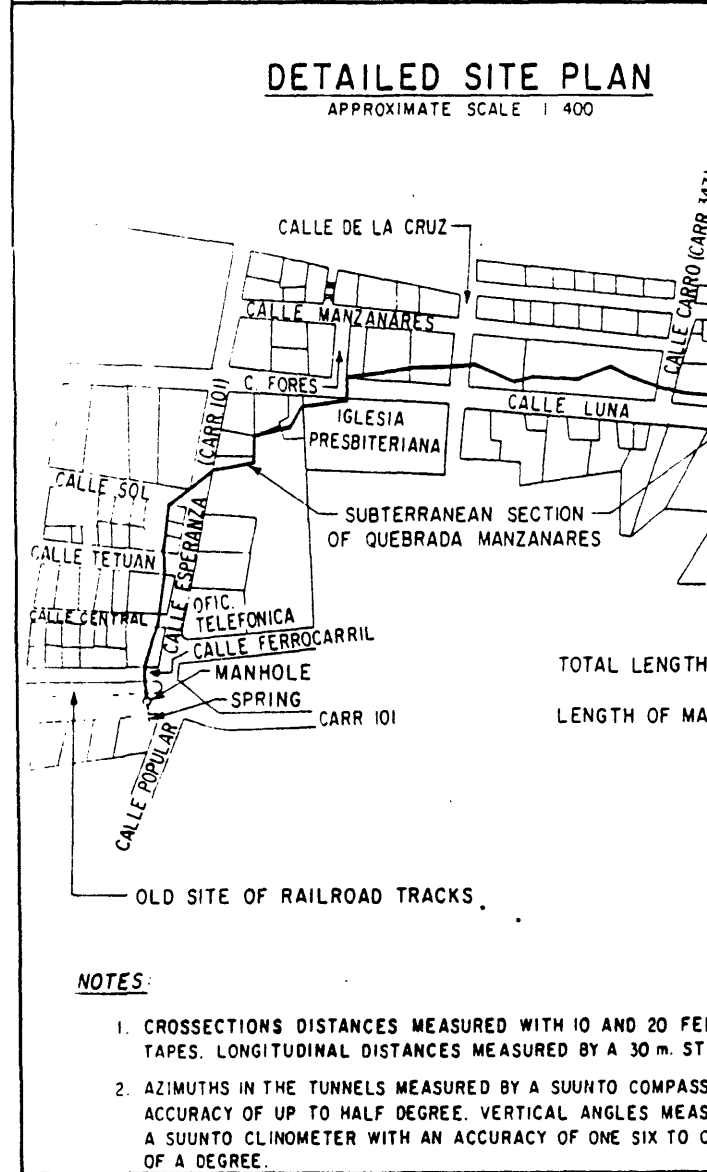
1. Latitude: 18°04'55"
Longitude: 67°02'44"
2. Latitude: 18°04'59"
Longitude: 67°02'44"
3. Latitude: 18°05'01"
Longitude: 67°02'40"
4. Latitude: 18°05'01"
Longitude: 67°02'27"
5. Latitude: 18°05'02"
Longitude: 67°02'25".



SYMBOLS AND ABBREVIATIONS

(SIMBOLOS Y ABBREVIATURAS)

| | | |
|----------------|--|---|
| | DIRECTION OF PERMANENT WATER FLOW
(DIRECCION DE FLUJO PERMANENTE DE AGUA) | S.W. STORM WATER
(P.L.) (PLUVIAL) |
| C.I. | CAST IRON
(H.C.) (HIERRO COLADO) | CONST. DISC. CONSTRUCTION DISCONTINUITY
(CAMBIO CONST.) (CAMBIO EN CONSTRUCCION) |
| DIA. | DIAMETER
(DIAMETRO) | W.W. WASTE WATER
(A.U.) (AGUAS USADAS) |
| CONC. | CONCRETE
(HORM.) (HORMIGON) | P.V.C. POLYVINYL CHLORIDE PLASTIC PIPE
(TUBERIA PLASTICO PVC) |

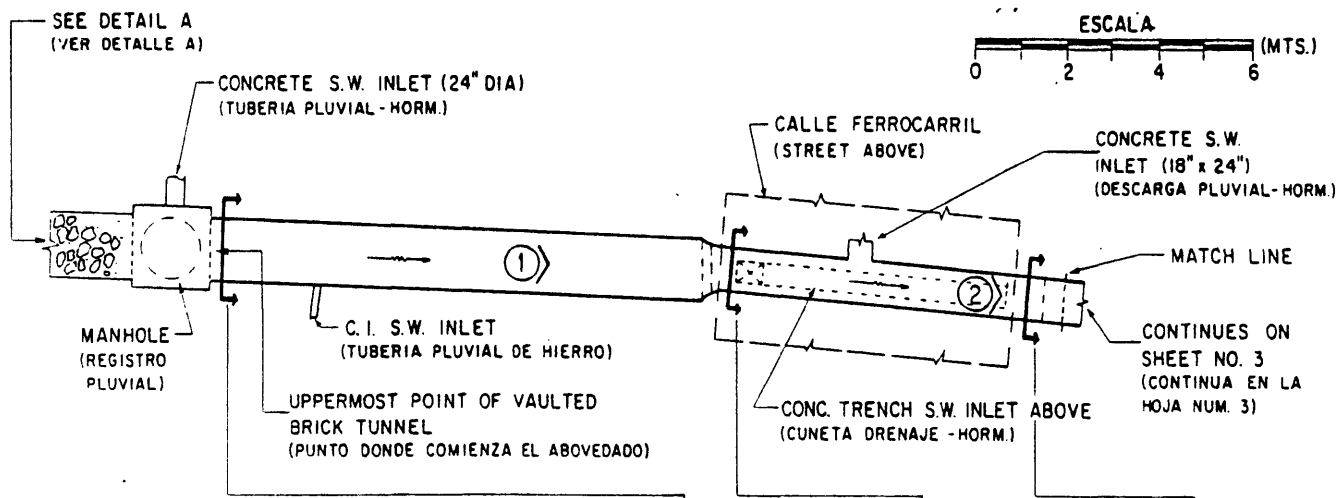
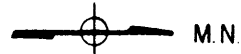


NOTES:

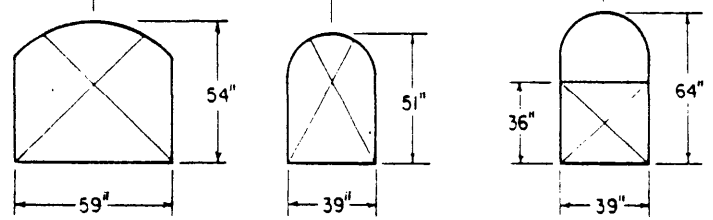
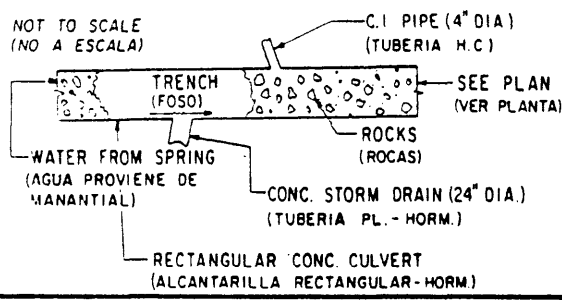
- CROSECTIONS DISTANCES MEASURED WITH 10 AND 20 FEET SURVEY TAPES. LONGITUDINAL DISTANCES MEASURED BY A 30 m. STEEL TAPE.
- AZIMUTHS IN THE TUNNELS MEASURED BY A SUUNTO COMPASS WITH AN ACCURACY OF UP TO HALF DEGREE. VERTICAL ANGLES MEASURED WITH A SUUNTO CLINOMETER WITH AN ACCURACY OF ONE SIX TO ONE FOURTH OF A DEGREE.

| | |
|--|---|
| MANZANARES CREEK VAULTED BRICK TUNNEL, SAN GERMAN, P.R. | |
| WATER RESOURCES RESEARCH INSTITUTE
FACULTY OF ENGINEERING, U.P.R., MAYAGUEZ | |
| PRINCIPAL INVESTIGATORS: | DR. LUIS F. PUMARADA
PROF. MIGUEL A. CRUZ AROCHO |
| SURVEY ASSISTANTS: | ANGEL NOEL COLON GUZMAN
RAFAEL B. TORRES LOPATEGUI |
| HISTORICAL RESEARCH: | EDWIN ALBINO |
| MAY-DECEMBER 1987 | |
| 1/30 | |

INTERIOR PLAN VIEW



DETAIL - A: HEAD OF MANZANARES CREEK (PLAN VIEW) (DETALLE - A NACIMIENTO QUEBRADA MANZANARES (PLANTA))

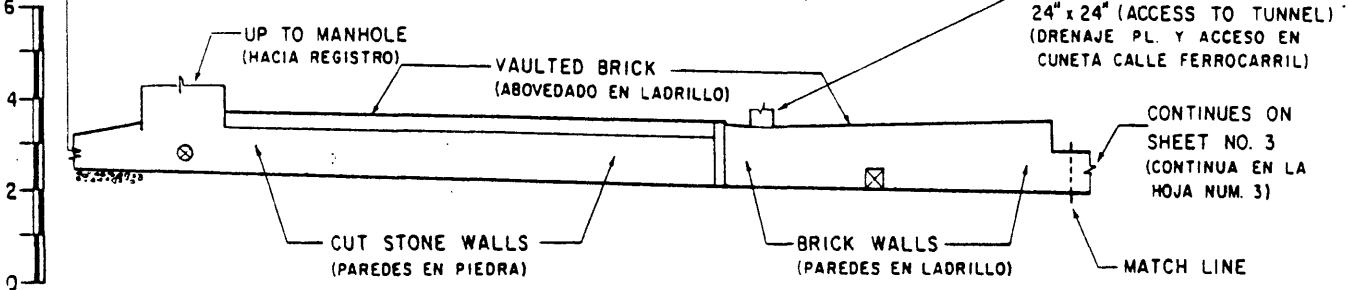


SECTIONS
(DOUBLE PLAN VIEW SCALE)

ESCALA (MTS.)

INTERIOR PROFILE VIEW

(HORIZONTAL NOT TO SCALE)

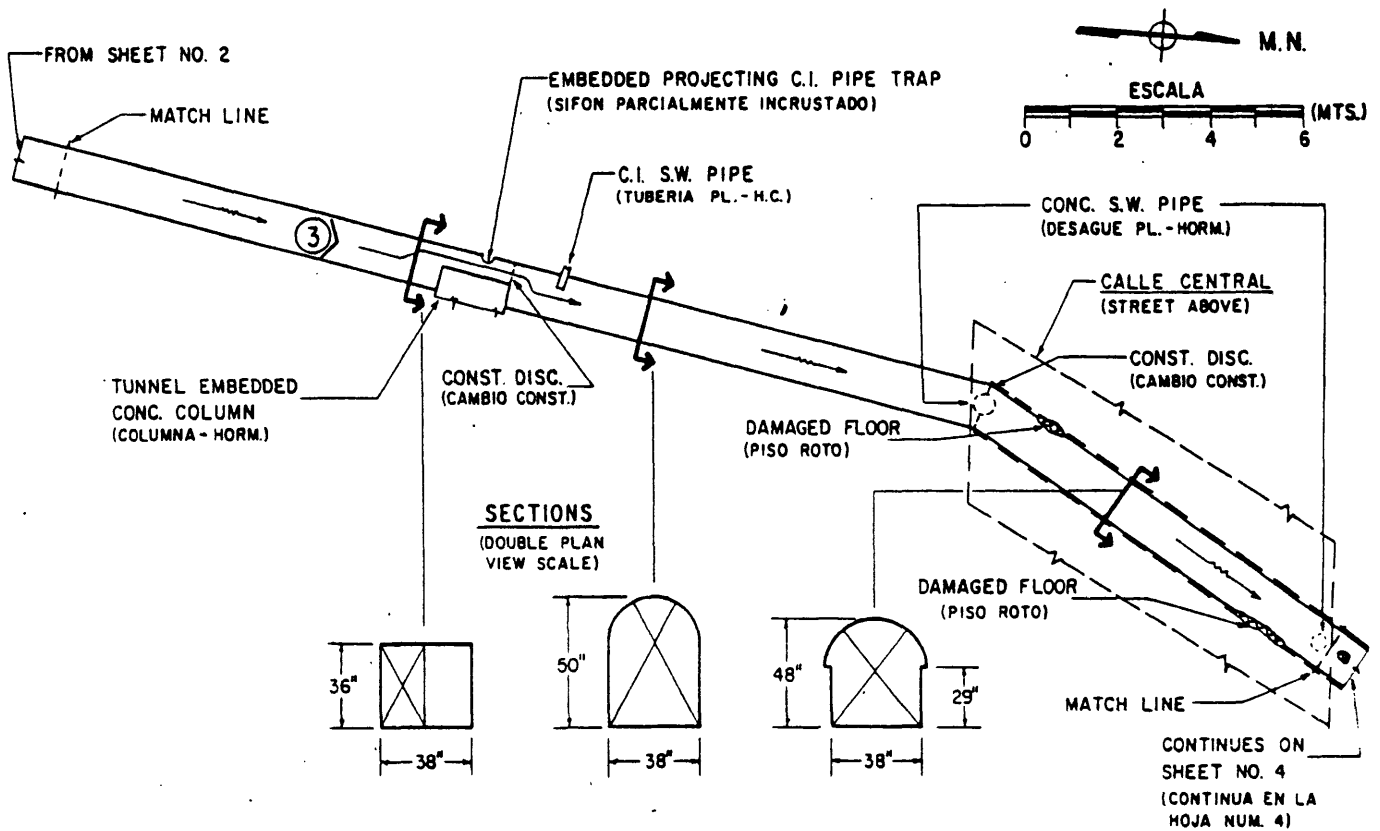


NOTE: FLOORS MADE OF CONCRETE
(TODOS LOS PISOS EN HORMIGON)

⑤ LOCATION AND DIRECTION OF CAMERA IN PHOTOGRAPH NO. 5

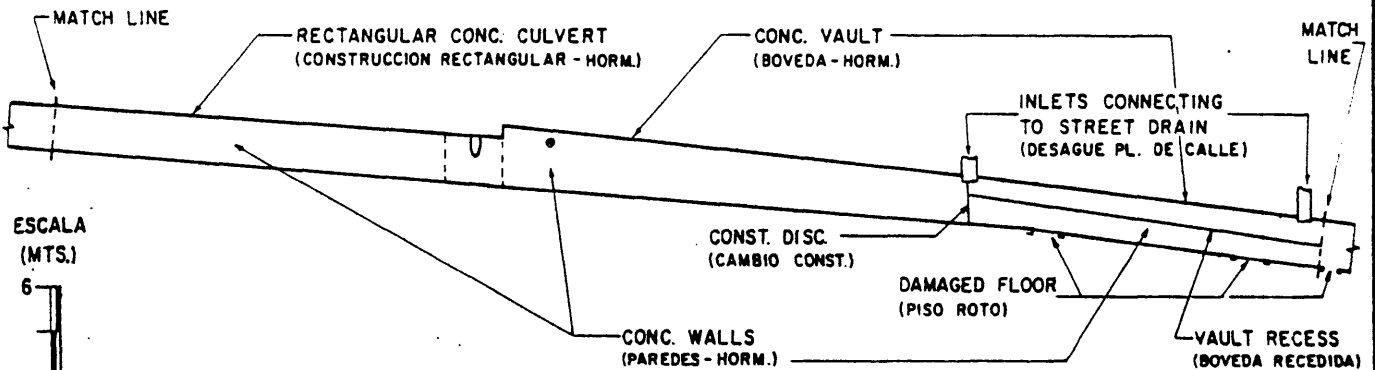
| | |
|--|-----------------------------|
| MANZANARES CREEK VAULTED BRICK TUNNEL, SAN GERMAN, P.R. | |
| WATER RESOURCES RESEARCH INSTITUTE
FACULTY OF ENGINEERING, U.P.R., MAYAGUEZ | |
| PRINCIPAL | DR. LUIS F. PUMARADA |
| INVESTIGATORS: | PROF. MIGUEL A. CRUZ AROCHO |
| SURVEY | ANGEL NOEL COLON GUZMAN |
| ASSISTANTS: | RAFAEL B. TORRES LOPATEGUI |
| HISTORICAL RESEARCH: | EDWIN ALBINO |
| MAY-DECEMBER 1987 | |
| 2 | 30 |

INTERIOR PLAN VIEW



INTERIOR PROFILE VIEW

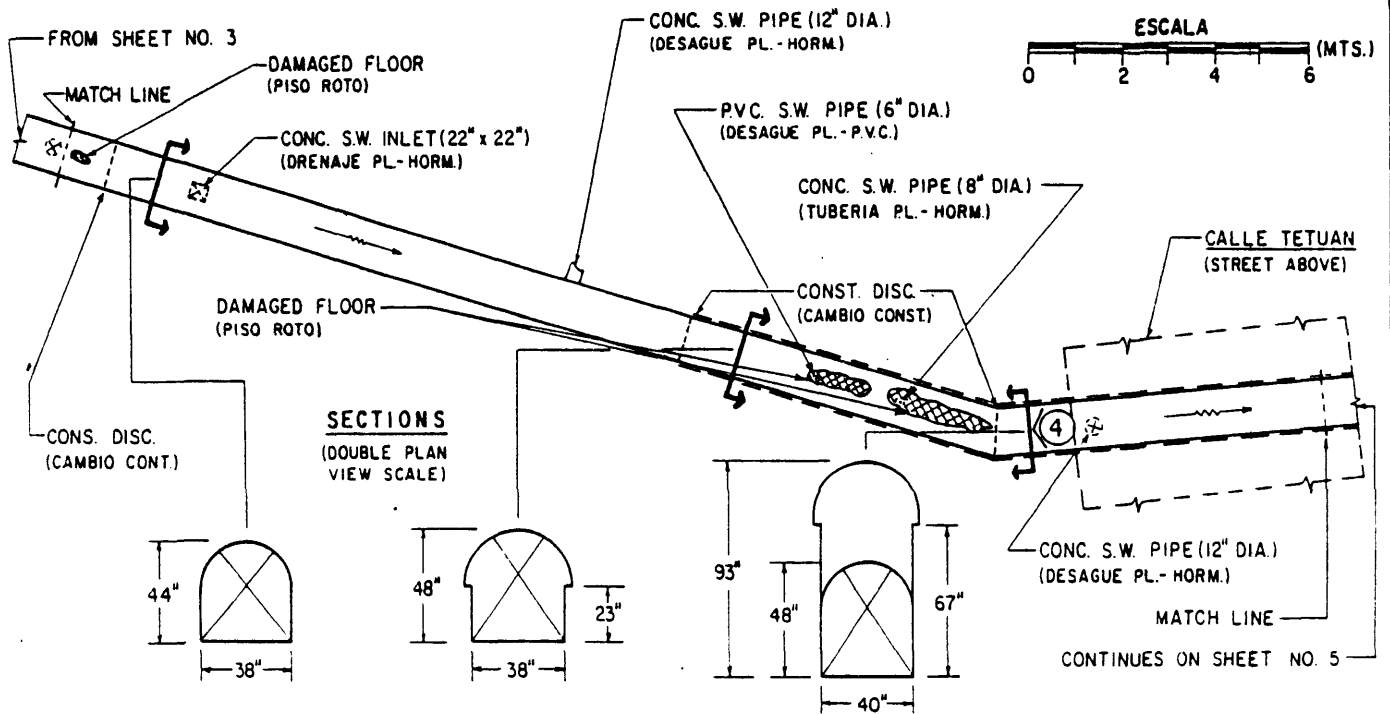
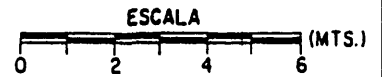
(HORIZONTAL NOT TO SCALE)



⑤ LOCATION AND DIRECTION OF CAMERA IN PHOTOGRAPH NO. 5

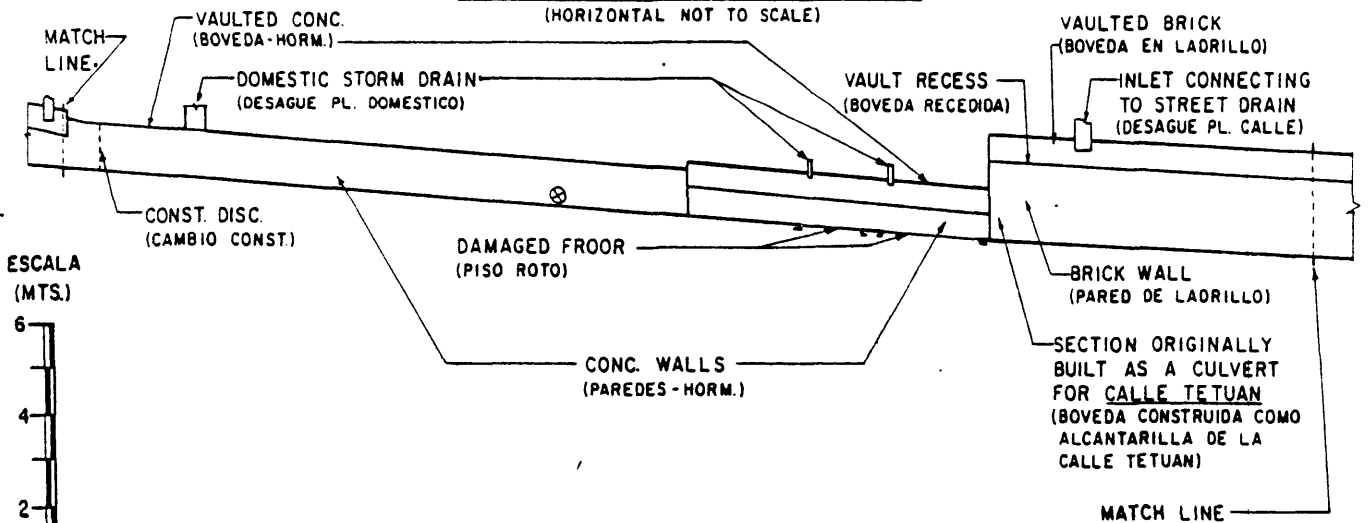
| | |
|--|-----------------------------|
| MANZANARES CREEK VAULTED BRICK TUNNEL, SAN GERMAN, P.R. | |
| WATER RESOURCES RESEARCH INSTITUTE
FACULTY OF ENGINEERING, U.P.R., MAYAGUEZ | |
| PRINCIPAL | DR. LUIS F. PUMARADA |
| INVESTIGATORS: | PROF. MIGUEL A. CRUZ AROCHO |
| SURVEY | ANGEL NOEL COLON GUZMAN |
| ASSISTANTS: | RAFAEL B. TORRES LOPATEGUI |
| HISTORICAL RESEARCH: | EDWIN ALBINO |
| MAY-DECEMBER 1987 | |
| 3 | 30 |

INTERIOR PLAN VIEW



INTERIOR PROFILE VIEW

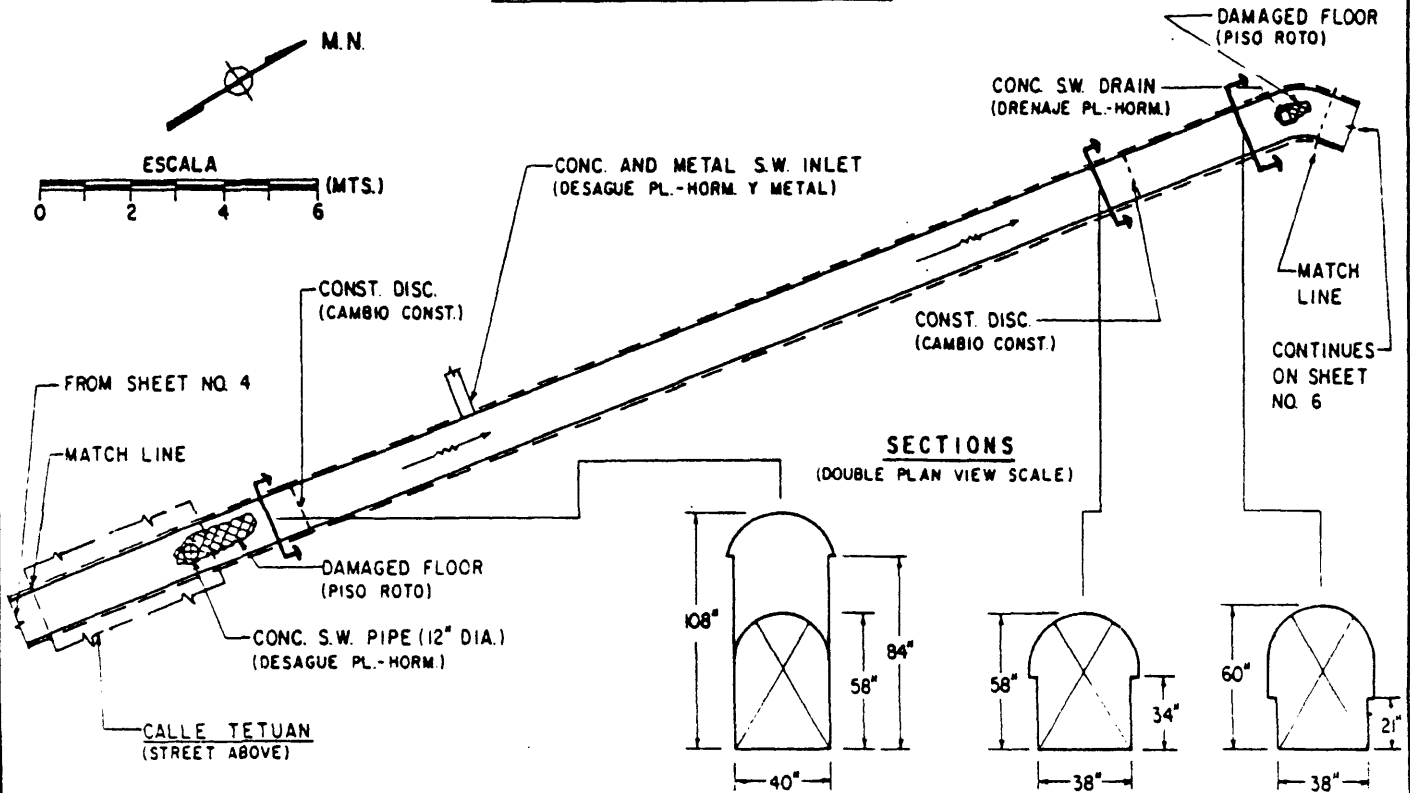
(HORIZONTAL NOT TO SCALE)



⑤ LOCATION AND DIRECTION OF CAMERA IN PHOTOGRAPH NO. 5

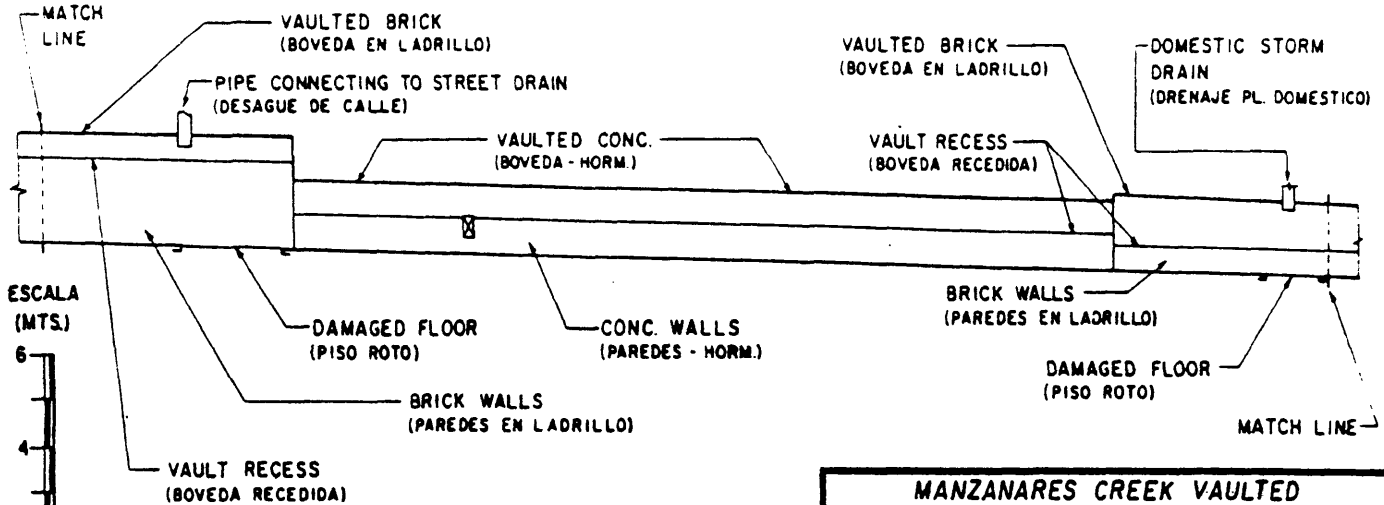
| | |
|--|-----------------------------|
| MANZANARES CREEK VAULTED BRICK TUNNEL, SAN GERMAN, P.R. | |
| WATER RESOURCES RESEARCH INSTITUTE
FACULTY OF ENGINEERING, U.P.R., MAYAGUEZ | |
| PRINCIPAL | DR. LUIS F. PUMARADA |
| INVESTIGATORS: | PROF. MIGUEL A. CRUZ AROCHO |
| SURVEY | ANGEL NOEL COLON GUZMAN |
| ASSISTANTS: | RAFAEL B. TORRES LOPATEGUI |
| HISTORICAL RESEARCH: | EDWIN ALBINO |
| MAY-DECEMBER 1987 | |
| 4 | 30 |

INTERIOR PLAN VIEW



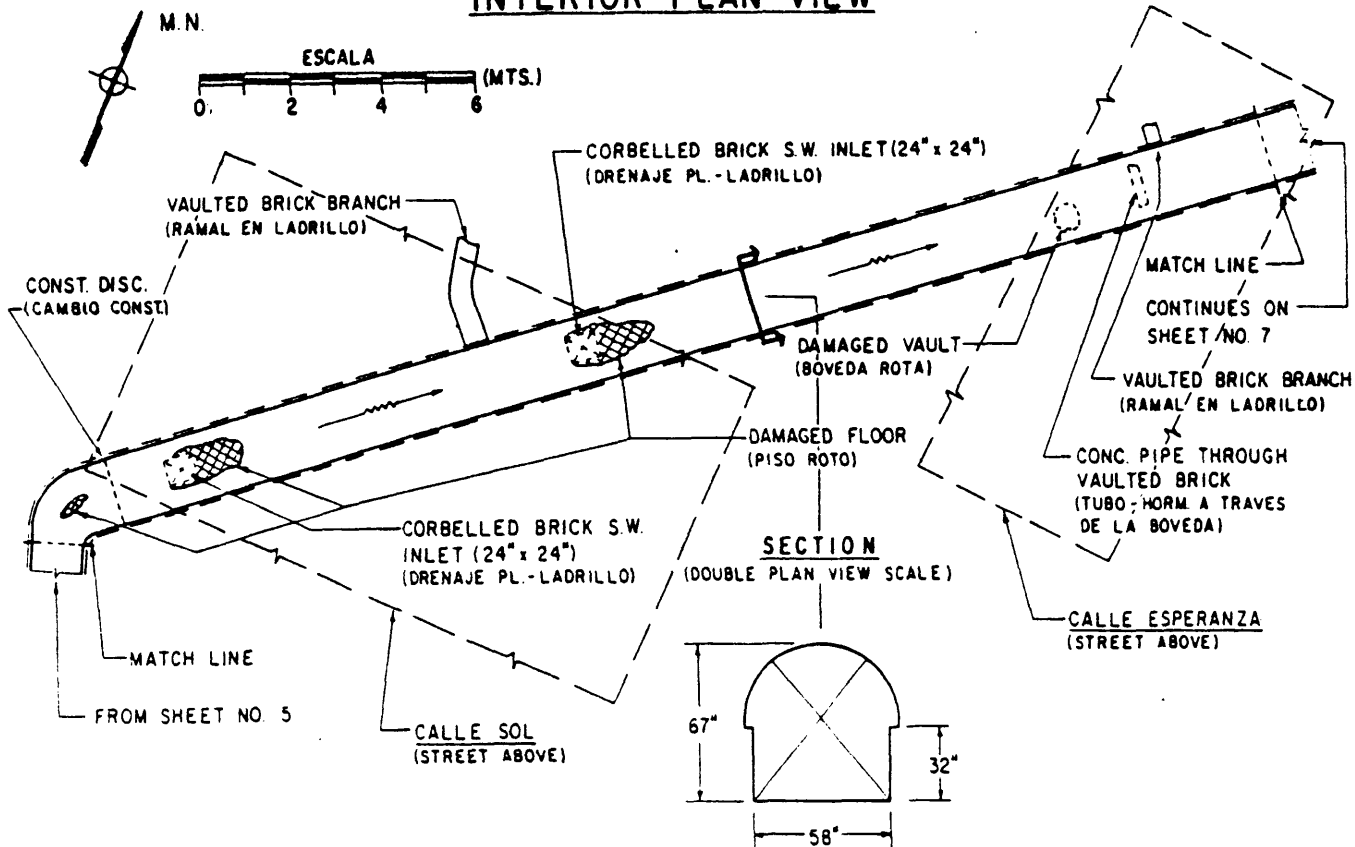
INTERIOR PROFILE VIEW

(HORIZONTAL NOT TO SCALE)



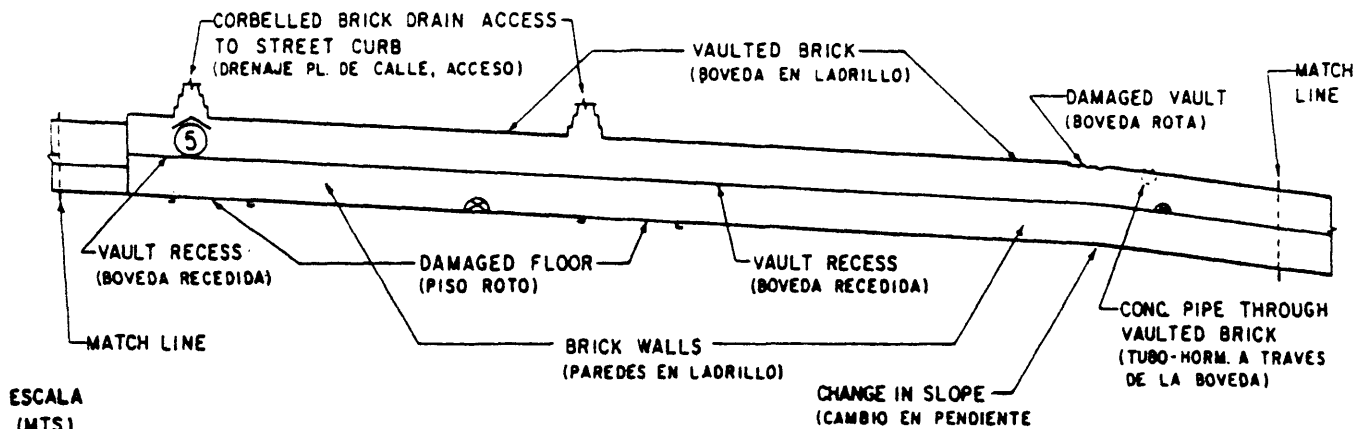
| | |
|--|-----------------------------|
| MANZANARES CREEK VAULTED
BRICK TUNNEL, SAN GERMAN, P.R. | |
| WATER RESOURCES RESEARCH INSTITUTE
FACULTY OF ENGINEERING, U.P.R., MAYAGUEZ | |
| PRINCIPAL | DR. LUIS F. PUMARADA |
| INVESTIGATORS: | PROF. MIGUEL A. CRUZ AROCHO |
| SURVEY | ANGEL NOEL COLON GUZMAN |
| ASSISTANTS: | RAFAEL B. TORRES LOPATEGUI |
| HISTORICAL
RESEARCH: | EDWIN ALBINO |
| MAY-DECEMBER 1987 | |
| 5 | 30 |

INTERIOR PLAN VIEW



INTERIOR PROFILE VIEW

(HORIZONTAL NOT TO SCALE)



ESCALA (MTS.)



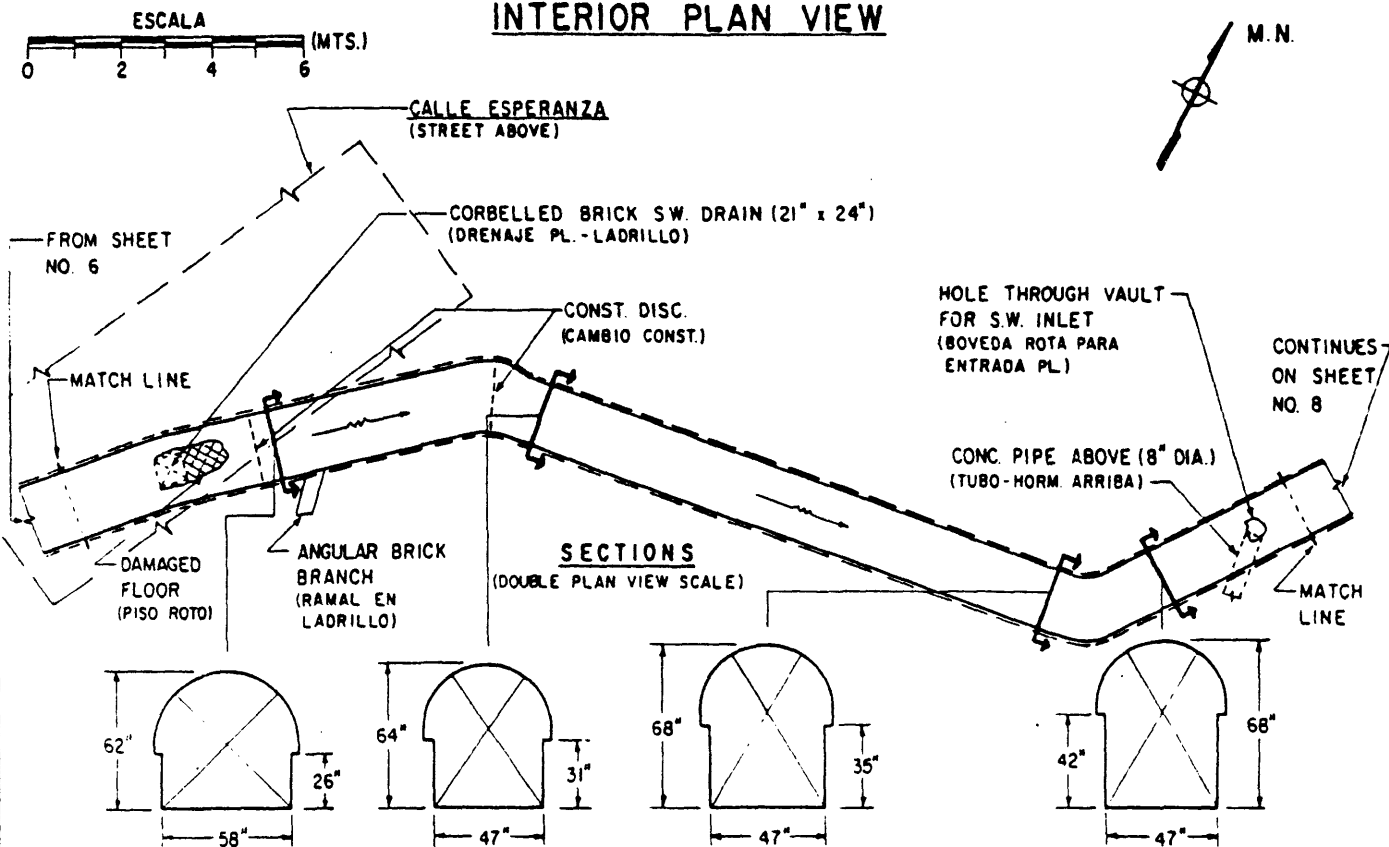
AVERAGE SLOPES:
(PENDIENTES PROMEDIO)

- 5% UNDER CALLE SOL
- 11% UNDER CALLE ESPERANZA

5 LOCATION AND DIRECTION OF CAMERA IN PHOTOGRAPH NO. 5

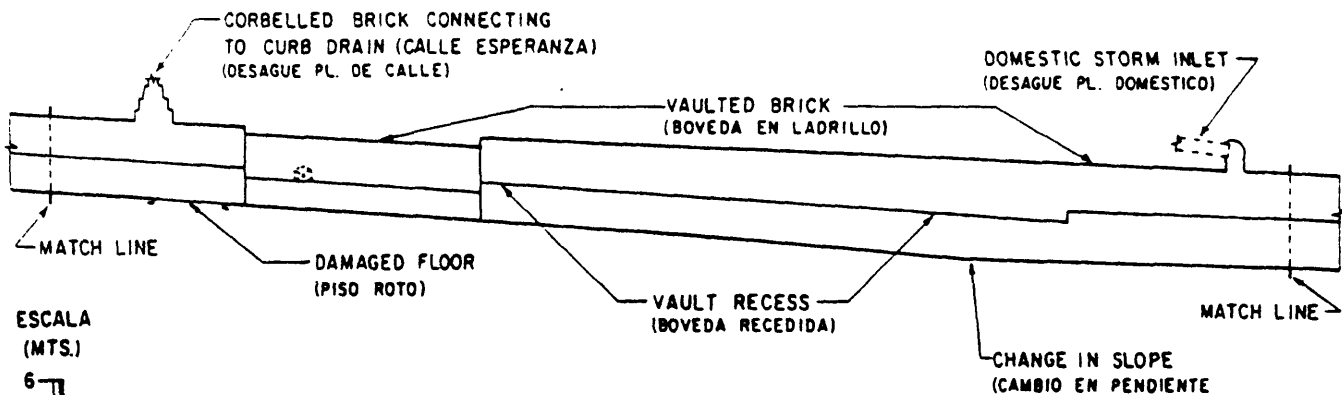
| | |
|--|-----------------------------|
| MANZANARES CREEK VAULTED BRICK TUNNEL, SAN GERMAN, P.R. | |
| WATER RESOURCES RESEARCH INSTITUTE
FACULTY OF ENGINEERING, U.P.R., MAYAGUEZ | |
| PRINCIPAL | DR. LUIS F. PUMARADA |
| INVESTIGATORS: | PROF. MIGUEL A. CRUZ AROCHO |
| SURVEY | ANGEL NOEL COLON GUZMAN |
| ASSISTANTS: | RAFAEL B. TORRES LOPATEGUI |
| HISTORICAL RESEARCH: | EDWIN ALBINO |
| MAY-DECEMBER 1987 | |
| 6 | 30 |

INTERIOR PLAN VIEW



INTERIOR PROFILE VIEW

(HORIZONTAL NOT TO SCALE)



ESCALA (MTS.)



AVERAGE SLOPES:
(PENDIENTES PROMEDIO)

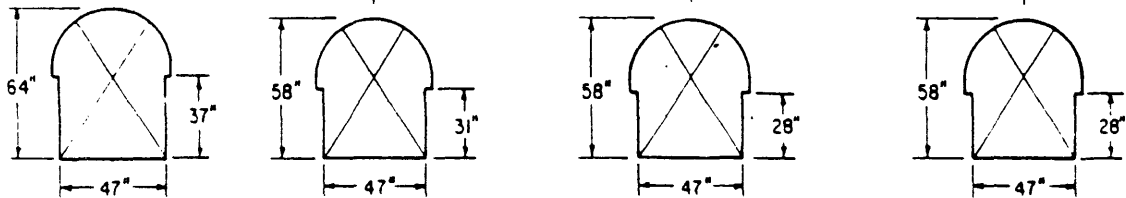
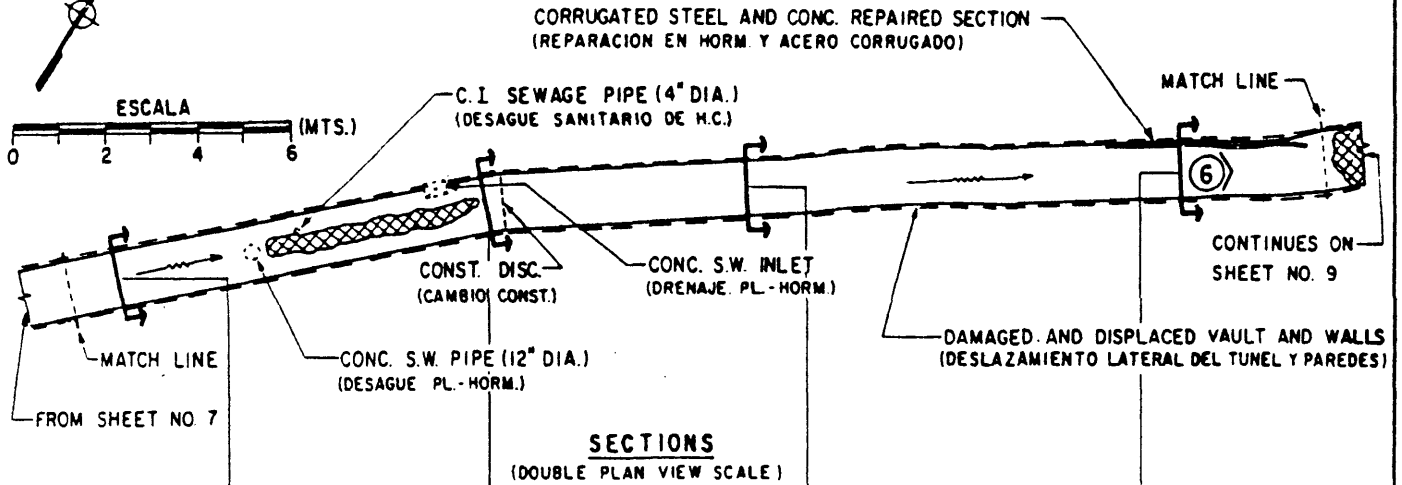
UPPER PART: 9%

LOWER PART: 5%

| | |
|--|-----------------------------|
| MANZANARES CREEK VAULTED
BRICK TUNNEL, SAN GERMAN, P.R. | |
| WATER RESOURCES RESEARCH INSTITUTE
FACULTY OF ENGINEERING, U.P.R., MAYAGUEZ | |
| PRINCIPAL | DR. LUIS F. PUMARADA |
| INVESTIGATORS: | PROF. MIGUEL A. CRUZ AROCHO |
| SURVEY | ANGEL NOEL COLON GUZMAN |
| ASSISTANTS: | RAFAEL B. TORRES LOPATEGUI |
| HISTORICAL
RESEARCH: | EDWIN ALBINO |
| MAY-DECEMBER 1987 | |
| 7 / 30 | |

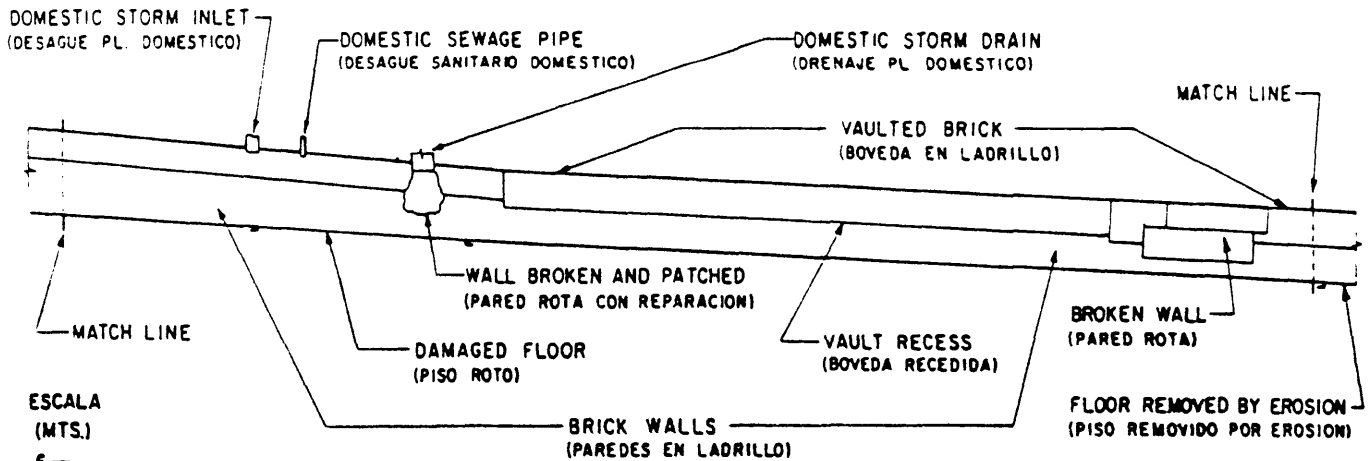
M. N.

INTERIOR PLAN VIEW



INTERIOR PROFILE VIEW

(HORIZONTAL NOT TO SCALE)

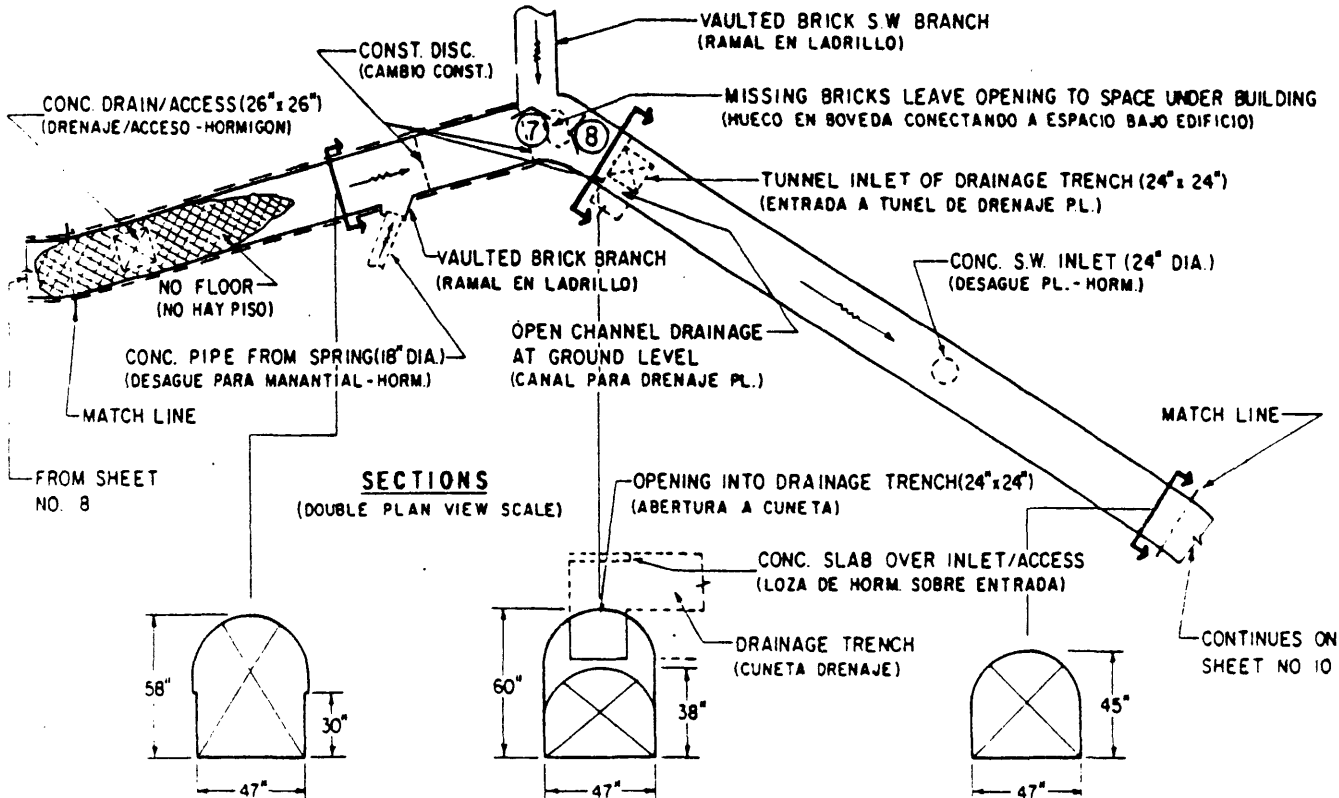
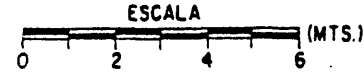


⑤ LOCATION AND DIRECTION OF CAMERA IN PHOTOGRAPH NO. 5

| | |
|--|-----------------------------|
| MANZANARES CREEK VAULTED BRICK TUNNEL, SAN GERMAN, P.R. | |
| WATER RESOURCES RESEARCH INSTITUTE
FACULTY OF ENGINEERING, U.P.R., MAYAGUEZ | |
| PRINCIPAL | DR. LUIS F. PUMARADA |
| INVESTIGATORS: | PROF. MIGUEL A. CRUZ AROCHO |
| SURVEY | ANGEL NOEL COLON GUZMAN |
| ASSISTANTS: | RAFAEL B. TORRES LOPATEGUI |
| HISTORICAL RESEARCH: | EDWIN ALBINO |
| MAY-DECEMBER 1987 | |
| 8 | 30 |

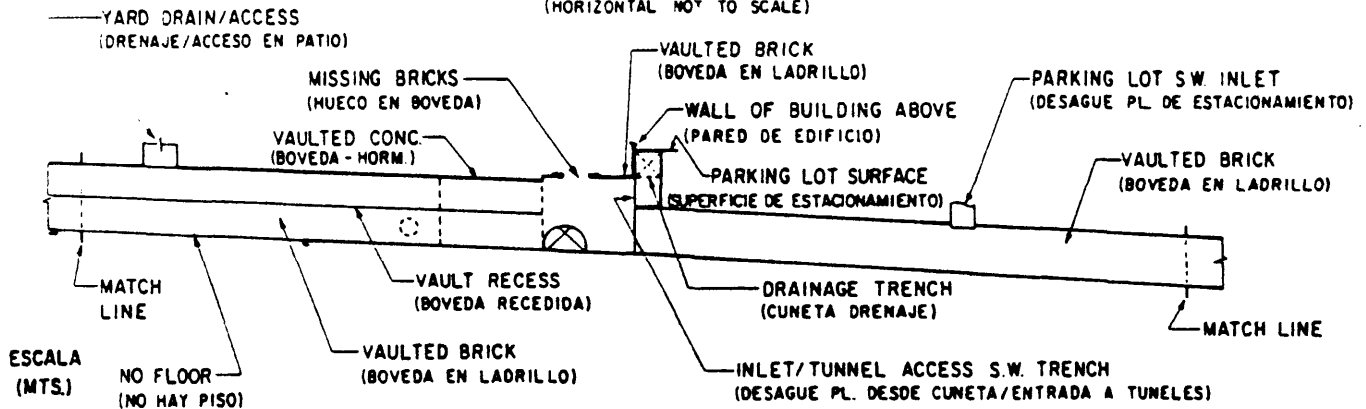
INTERIOR PLAN VIEW

M.N.



INTERIOR PROFILE VIEW

(HORIZONTAL NOT TO SCALE)

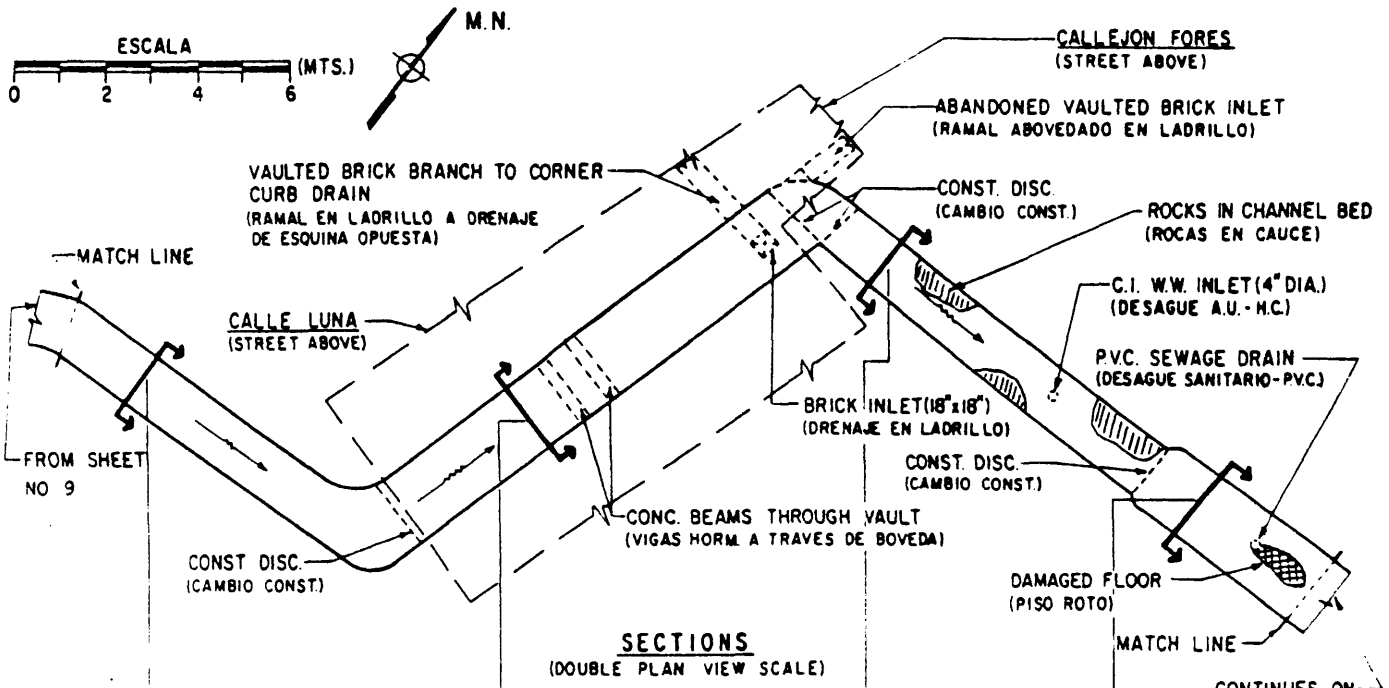


AVERAGE SLOPE: -3%
(PENDIENTE PROMEDIO)

⑤ LOCATION AND DIRECTION OF CAMERA IN PHOTOGRAPH NO. 5

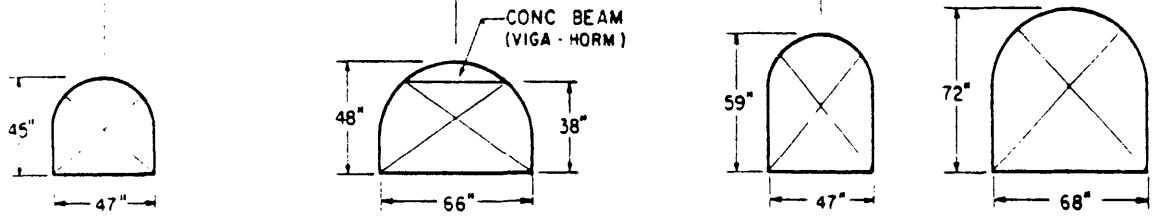
| | |
|--|---|
| MANZANARES CREEK VAULTED BRICK TUNNEL, SAN GERMAN, P.R. | |
| WATER RESOURCES RESEARCH INSTITUTE
FACULTY OF ENGINEERING, U.P.R., MAYAGUEZ | |
| PRINCIPAL INVESTIGATORS: | DR. LUIS F. PUMARADA
PROF. MIGUEL A. CRUZ AROCHO |
| SURVEY ASSISTANTS: | ANGEL NOEL COLON GUZMAN
RAFAEL B. TORRES LOPATEGUI |
| HISTORICAL RESEARCH: | EDWIN ALBINO |
| MAY-DECEMBER 1987 | |
| 9 | 30 |

INTERIOR PLAN VIEW



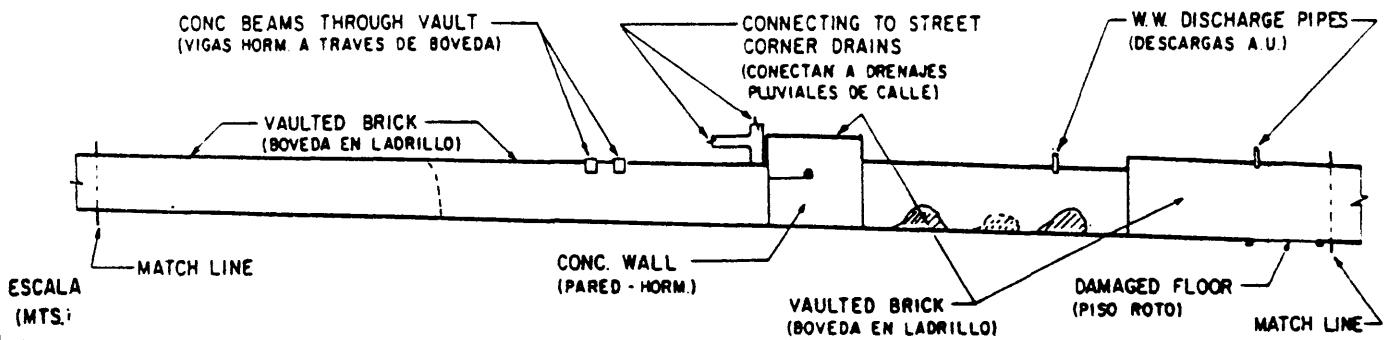
SECTIONS

(DOUBLE PLAN VIEW SCALE)



INTERIOR PROFILE VIEW

(HORIZONTAL NOT TO SCALE)



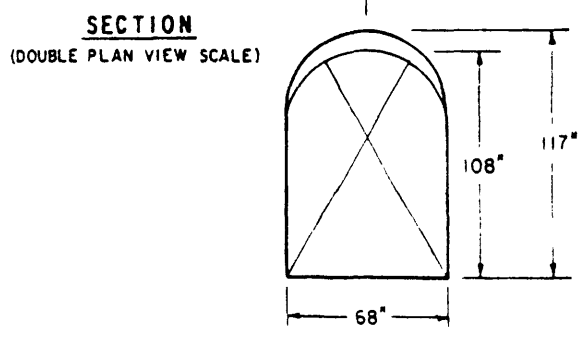
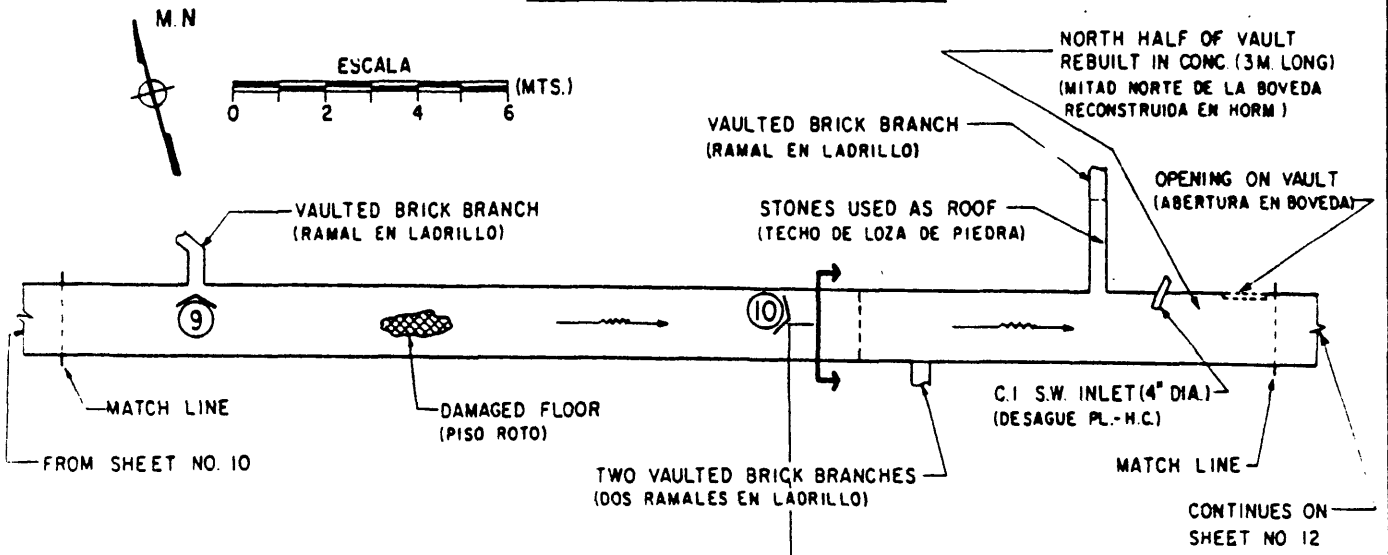
ESCALA (MTS.)



AVERAGE SLOPE: -3%
(PENDIENTE PROMEDIO)

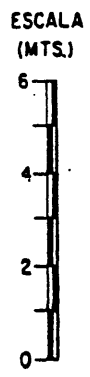
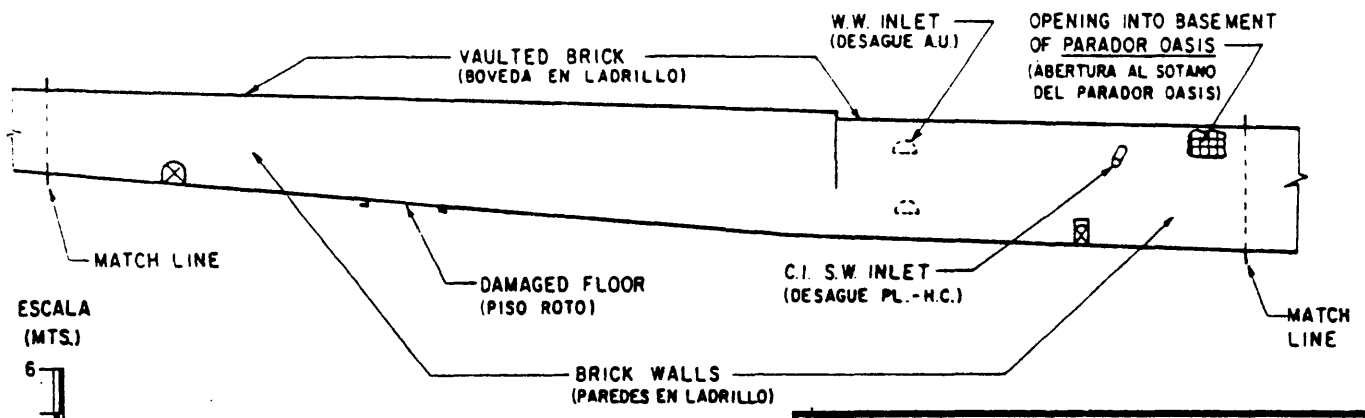
| | |
|--|-----------------------------|
| MANZANARES CREEK VAULTED
BRICK TUNNEL, SAN GERMAN, P.R. | |
| WATER RESOURCES RESEARCH INSTITUTE
FACULTY OF ENGINEERING, U.P.R., MAYAGUEZ | |
| PRINCIPAL | DR. LUIS F. PUMARADA |
| INVESTIGATORS: | PROF. MIGUEL A. CRUZ AROCHO |
| SURVEY | ANGEL NOEL COLON GUZMAN |
| ASSISTANTS: | RAFAEL B. TORRES LOPATEGU |
| HISTORICAL RESEARCH: | EDWIN ALBINO |
| MAY-DECEMBER 1987 | |

INTERIOR PLAN VIEW



INTERIOR PROFILE VIEW

(HORIZONTAL NOT TO SCALE)

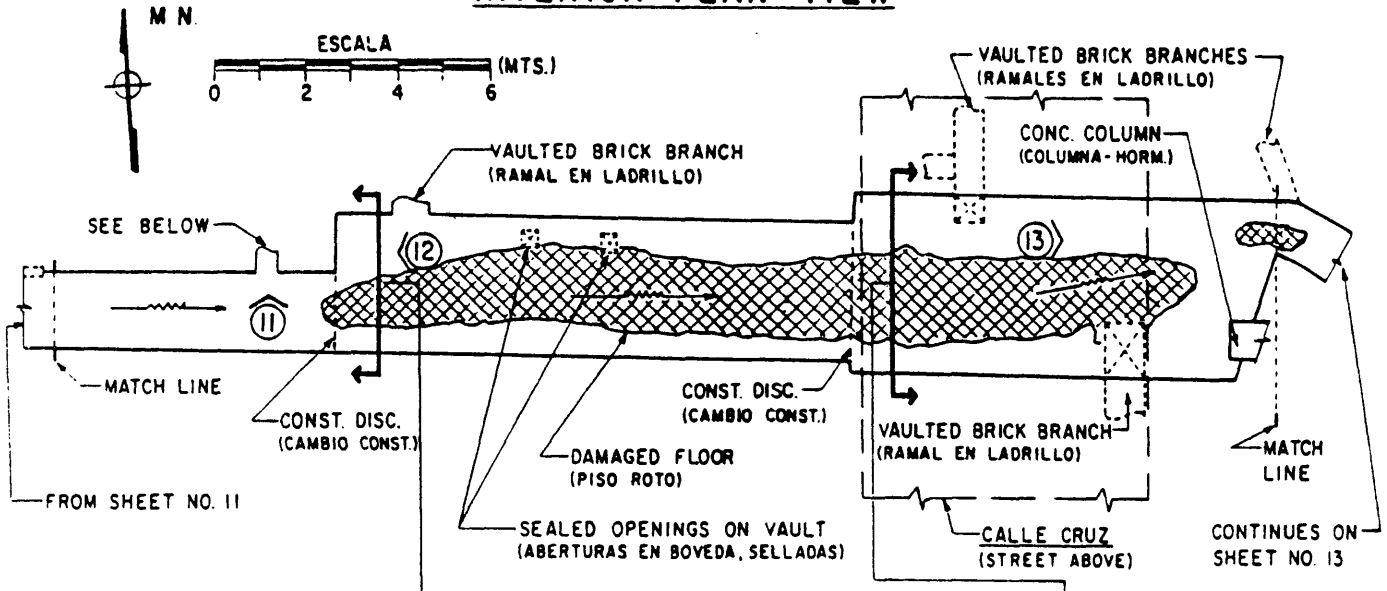


AVERAGE SLOPE: $\approx -3\%$
(PENDIENTE PROMEDIO)

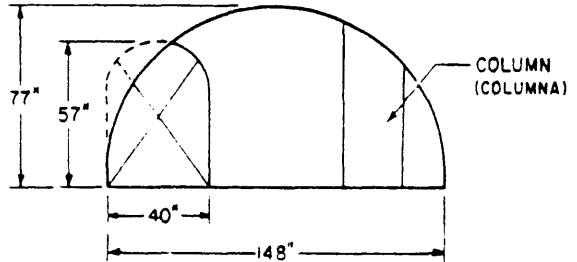
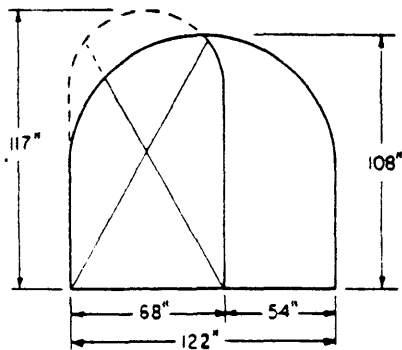
⑤ LOCATION AND DIRECTION OF CAMERA IN PHOTOGRAPH NO. 5

| | |
|--|-----------------------------|
| MANZANARES CREEK VAULTED
BRICK TUNNEL, SAN GERMAN, P.R. | |
| WATER RESOURCES RESEARCH INSTITUTE
FACULTY OF ENGINEERING, U.P.R., MAYAGUEZ | |
| PRINCIPAL | DR. LUIS F. PUMARADA |
| INVESTIGATORS: | PROF. MIGUEL A. CRUZ AROCHO |
| SURVEY | ANGEL NOEL COLON GUZMAN |
| ASSISTANTS: | RAFAEL B. TORRES LOPATEGUI |
| HISTORICAL
RESEARCH: | EDWIN ALBINO |
| MAY-DECEMBER 1987 | |
| 11 | 30 |

INTERIOR PLAN VIEW

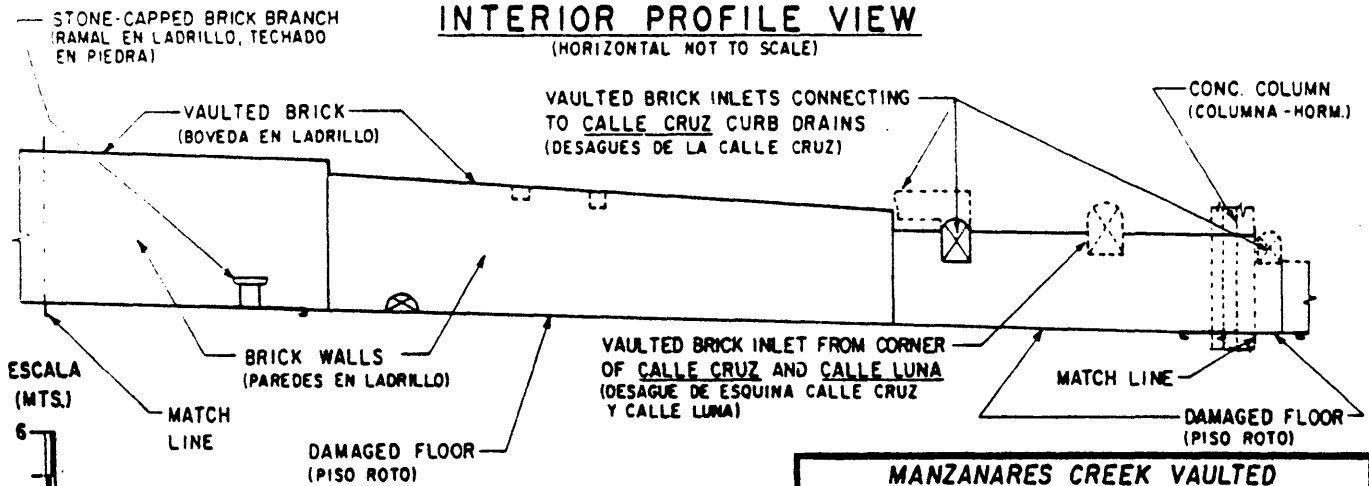


SECTIONS (DOUBLE PLAN VIEW SCALE)



INTERIOR PROFILE VIEW

(HORIZONTAL NOT TO SCALE)

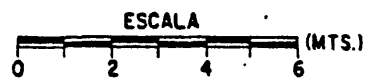
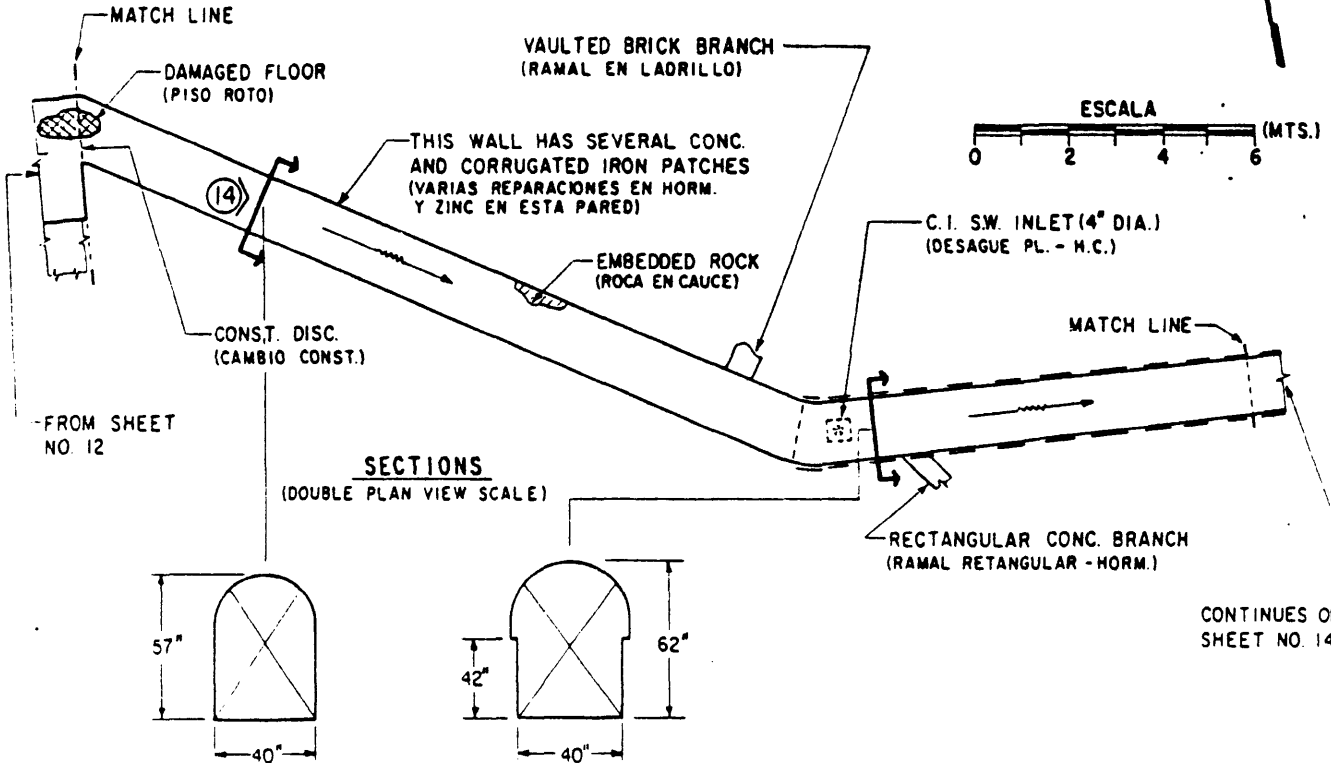


AVERAGE SLOPE: - 3%
(PENDIENTE PROMEDIO)

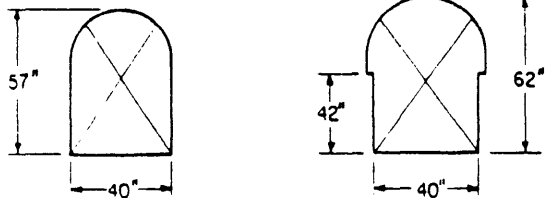
⑤ LOCATION AND DIRECTION OF CAMERA IN PHOTOGRAPH NO. 5

| | |
|--|-----------------------------|
| MANZANARES CREEK VAULTED BRICK TUNNEL, SAN GERMAN, P.R. | |
| WATER RESOURCES RESEARCH INSTITUTE
FACULTY OF ENGINEERING, U.P.R., MAYAGUEZ | |
| PRINCIPAL | DR. LUIS F. PUMARADA |
| INVESTIGATORS: | PROF. MIGUEL A. CRUZ AROCHO |
| SURVEY | ANGEL NOEL COLON GUZMAN |
| ASSISTANTS: | RAFAEL B. TORRES LOPATEGUI |
| HISTORICAL RESEARCH: | EDWIN ALBINO |
| MAY-DECEMBER 1987 | |

INTERIOR PLAN VIEW



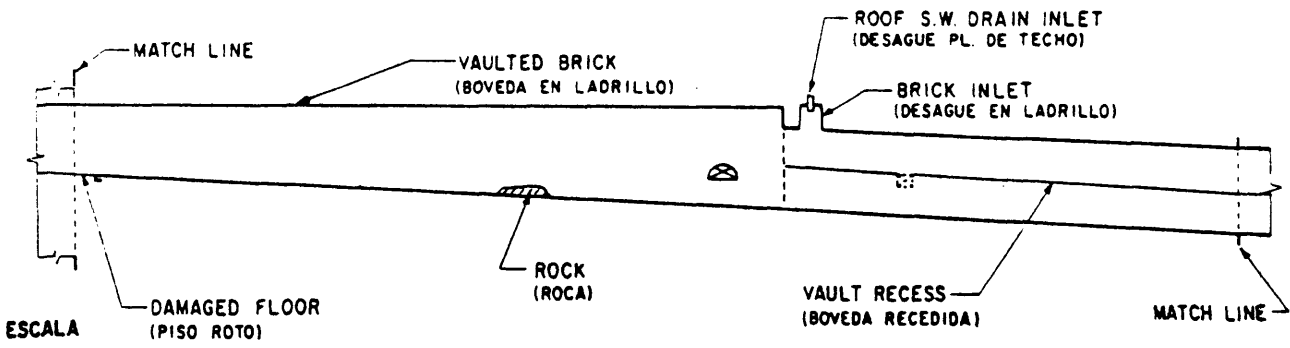
SECTIONS (DOUBLE PLAN VIEW SCALE)



CONTINUES ON SHEET NO. 14

INTERIOR PROFILE VIEW

(HORIZONTAL NOT TO SCALE)

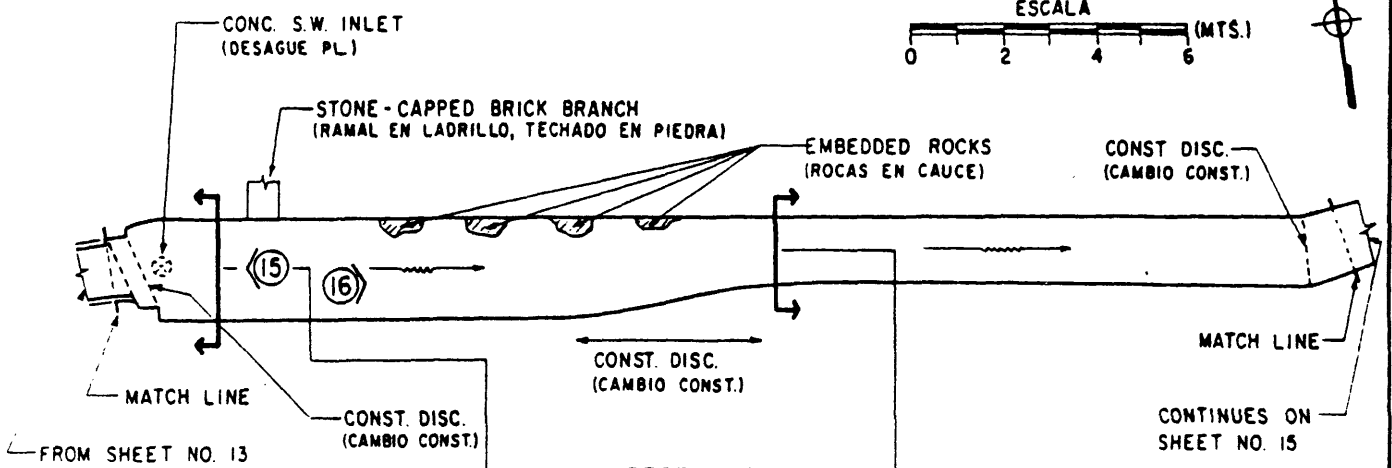


AVERAGE SLOPE: -3%
(PENDIENTE PROMEDIO)

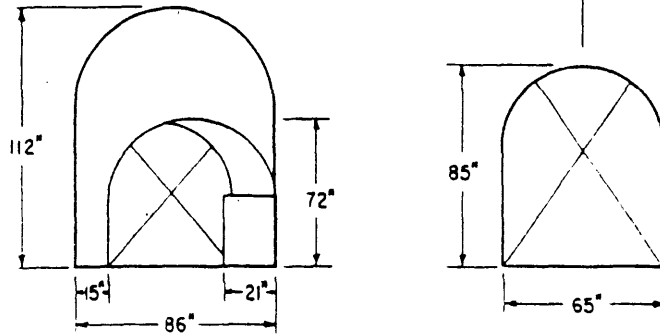
⑤ LOCATION AND DIRECTION OF CAMERA IN PHOTOGRAPH NO. 5

| | |
|--|-----------------------------|
| MANZANARES CREEK VAULTED BRICK TUNNEL, SAN GERMAN, P.R. | |
| WATER RESOURCES RESEARCH INSTITUTE
FACULTY OF ENGINEERING, U.P.R., MAYAGUEZ | |
| PRINCIPAL | DR. LUIS F. PUMARADA |
| INVESTIGATORS: | PROF. MIGUEL A. CRUZ AROCHO |
| SURVEY | ANGEL NOEL COLON GUZMAN |
| ASSISTANTS: | RAFAEL B. TORRES LOPATEGUI |
| HISTORICAL RESEARCH: | EDWIN ALBINO |
| MAY-DECEMBER 1987 | |

INTERIOR PLAN VIEW

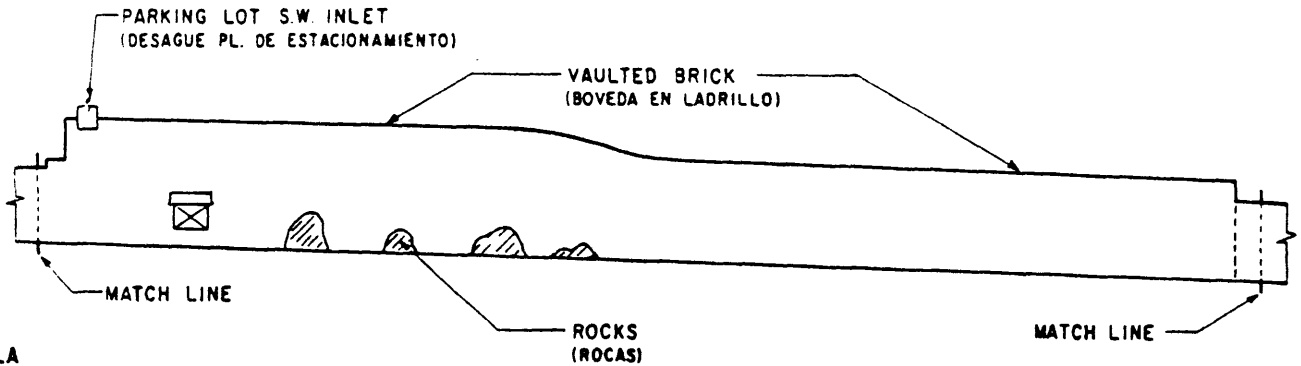


SECTIONS (DOUBLE PLAN VIEW SCALE)



INTERIOR PROFILE VIEW

(HORIZONTAL NOT TO SCALE)



ESCALA (MTS.)

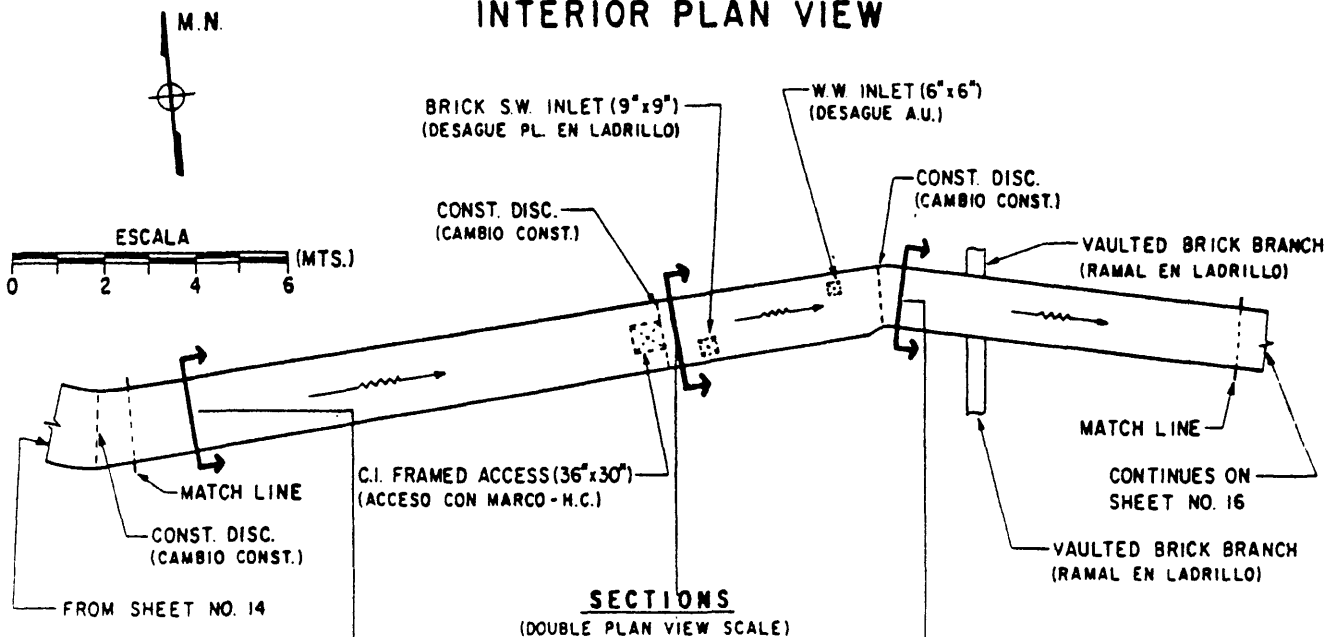


AVERAGE SLOPE: \pm -3%
(PENDIENTE PROMEDIO)

(5) LOCATION AND DIRECTION OF CAMERA IN PHOTOGRAPH NO. 5

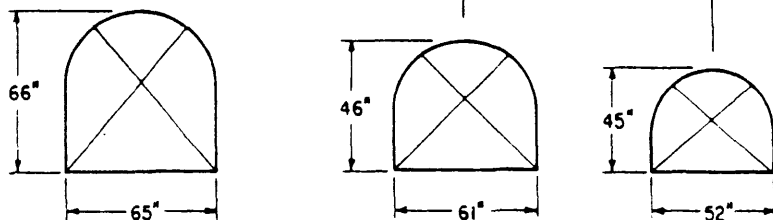
| | |
|--|-----------------------------|
| MANZANARES CREEK VAULTED BRICK TUNNEL, SAN GERMAN, P.R. | |
| WATER RESOURCES RESEARCH INSTITUTE
FACULTY OF ENGINEERING, U.P.R., MAYAGUEZ | |
| PRINCIPAL | DR. LUIS F. PUMARADA |
| INVESTIGATORS: | PROF. MIGUEL A. CRUZ AROCHO |
| SURVEY | ANGEL NOEL COLON GUZMAN |
| ASSISTANTS: | RAFAEL B. TORRES LOPATEGUI |
| HISTORICAL RESEARCH: | EDWIN ALBINO |
| MAY-DECEMBER 1987 | |
| 14 / 30 | |

INTERIOR PLAN VIEW



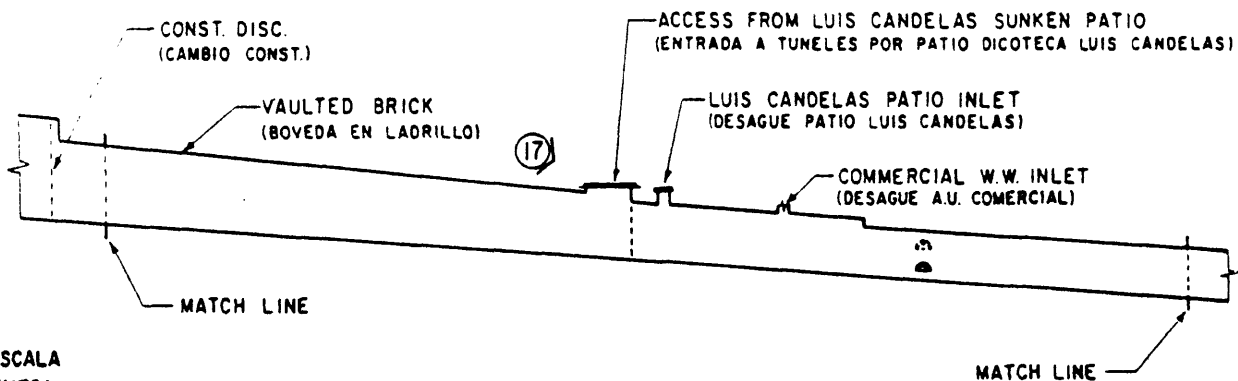
SECTIONS

(DOUBLE PLAN VIEW SCALE)



INTERIOR PROFILE VIEW

(HORIZONTAL NOT TO SCALE)



ESCALA
(MTS.)



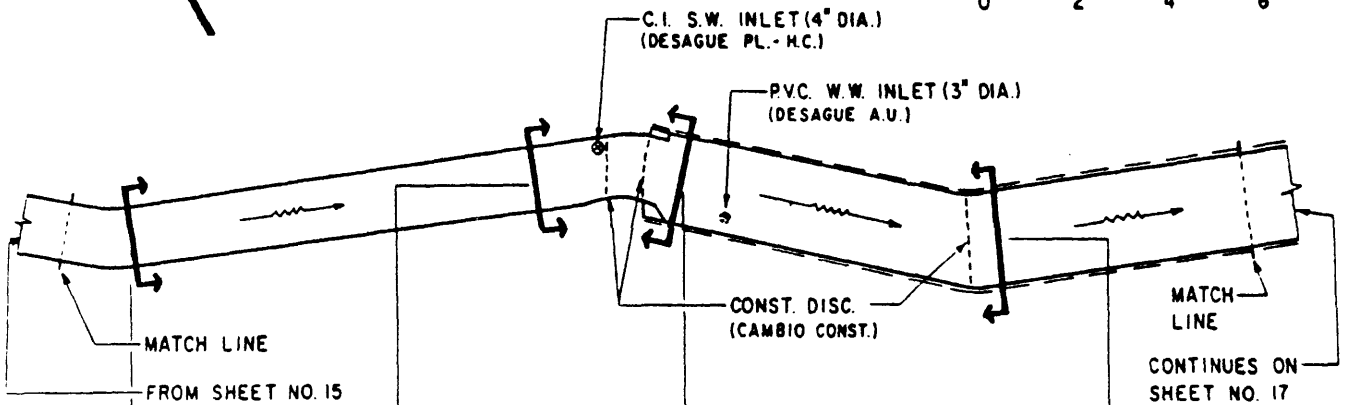
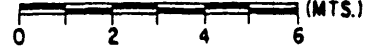
⑤ LOCATION AND DIRECTION OF
CAMERA IN PHOTOGRAPH NO. 5

| | |
|--|-----------------------------|
| MANZANARES CREEK VAULTED
BRICK TUNNEL, SAN GERMAN, P.R. | |
| WATER RESOURCES RESEARCH INSTITUTE
FACULTY OF ENGINEERING, U.P.R., MAYAGUEZ | |
| PRINCIPAL | DR. LUIS F. PUMARADA |
| INVESTIGATORS: | PROF. MIGUEL A. CRUZ AROCHO |
| SURVEY | ANGEL NOEL COLON GUZMAN |
| ASSISTANTS: | RAFAEL B. TORRES LOPATEGUI |
| HISTORICAL
RESEARCH: | EDWIN ALBINO |
| MAY-DECEMBER 1987 | |
| | 15
30 |

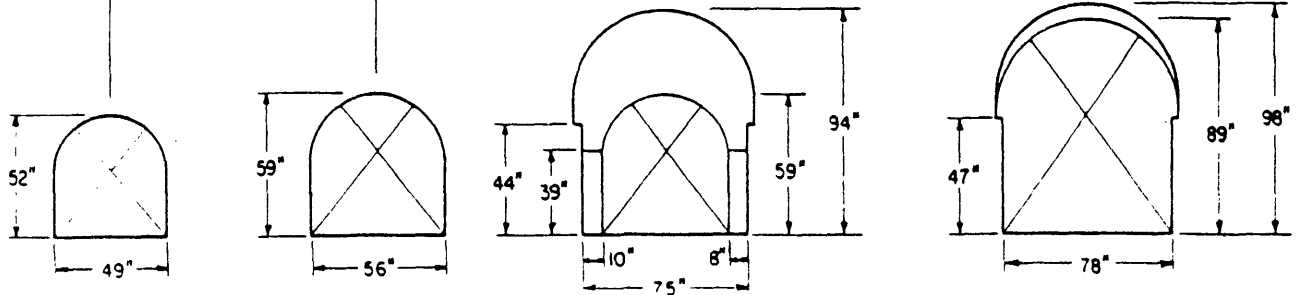
M N

INTERIOR PLAN VIEW

ESCALA

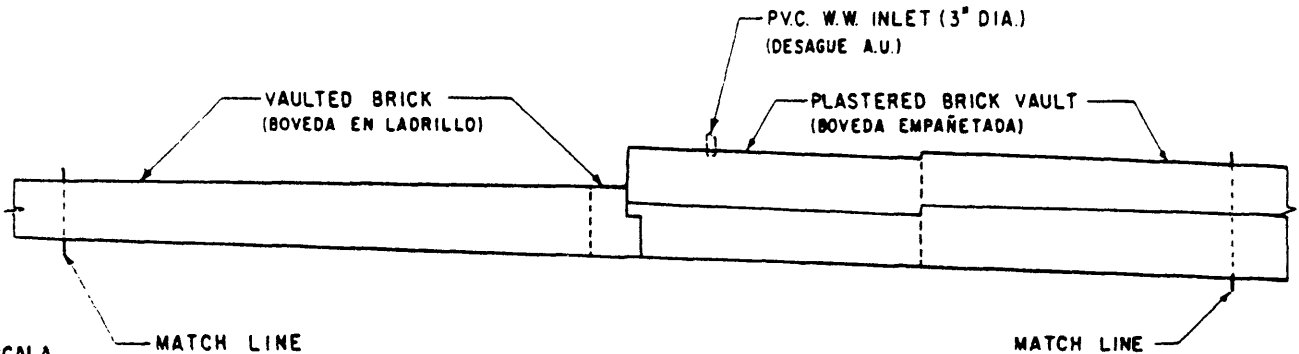


SECTIONS (DOUBLE PLAN VIEW SCALE)



INTERIOR PROFILE VIEW

(HORIZONTAL NOT TO SCALE)

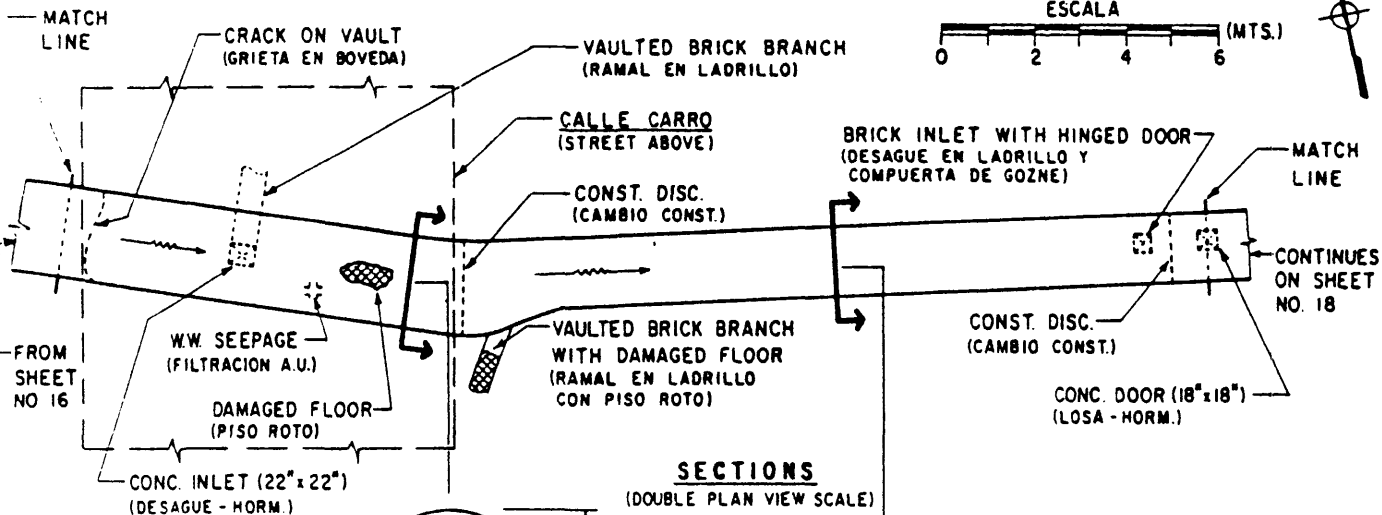
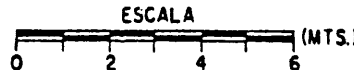
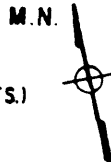


ESCALA
(MTS.)

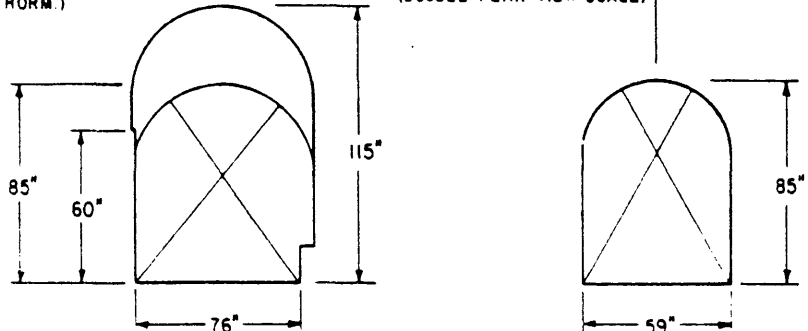


| | |
|--|-----------------------------|
| MANZANARES CREEK VAULTED BRICK TUNNEL, SAN GERMAN, P.R. | |
| WATER RESOURCES RESEARCH INSTITUTE
FACULTY OF ENGINEERING, U.P.R., MAYAGUEZ | |
| PRINCIPAL | DR. LUIS F. PUMARADA |
| INVESTIGATORS: | PROF. MIGUEL A. CRUZ AROCHO |
| SURVEY | ANGEL HOEL COLON GUZMAN |
| ASSISTANTS: | RAFAEL B. TORRES LOPATEGUI |
| HISTORICAL RESEARCH: | EDWIN ALBINO |
| MAY-DECEMBER 1987 | |
| 16 | 30 |

INTERIOR PLAN VIEW

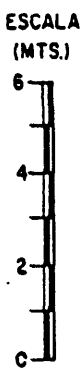
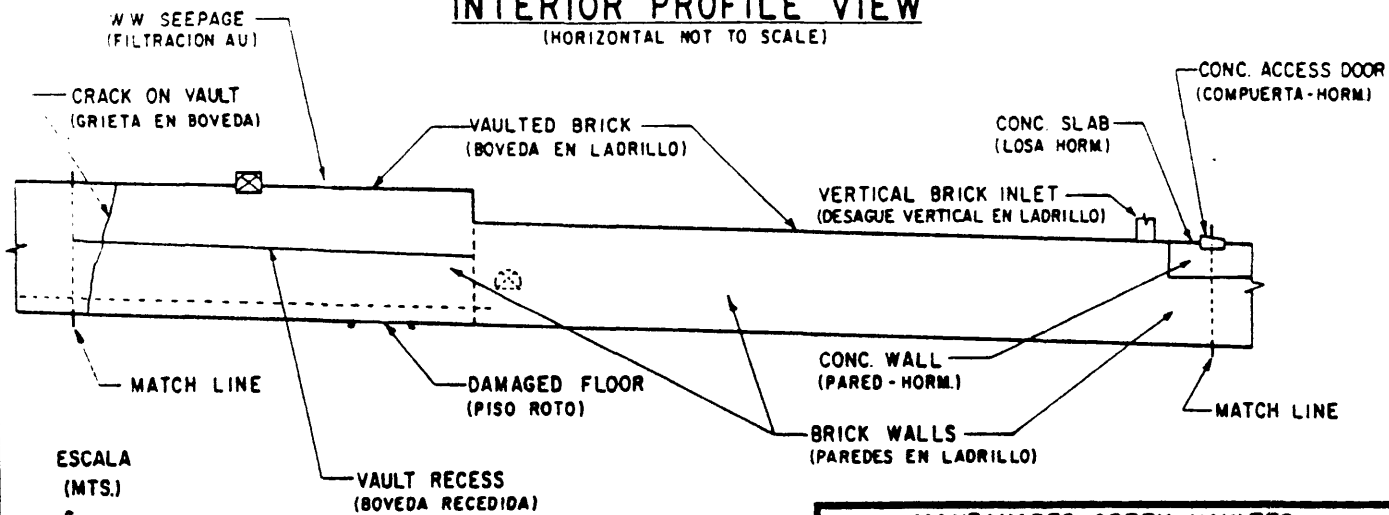


SECTIONS (DOUBLE PLAN VIEW SCALE)



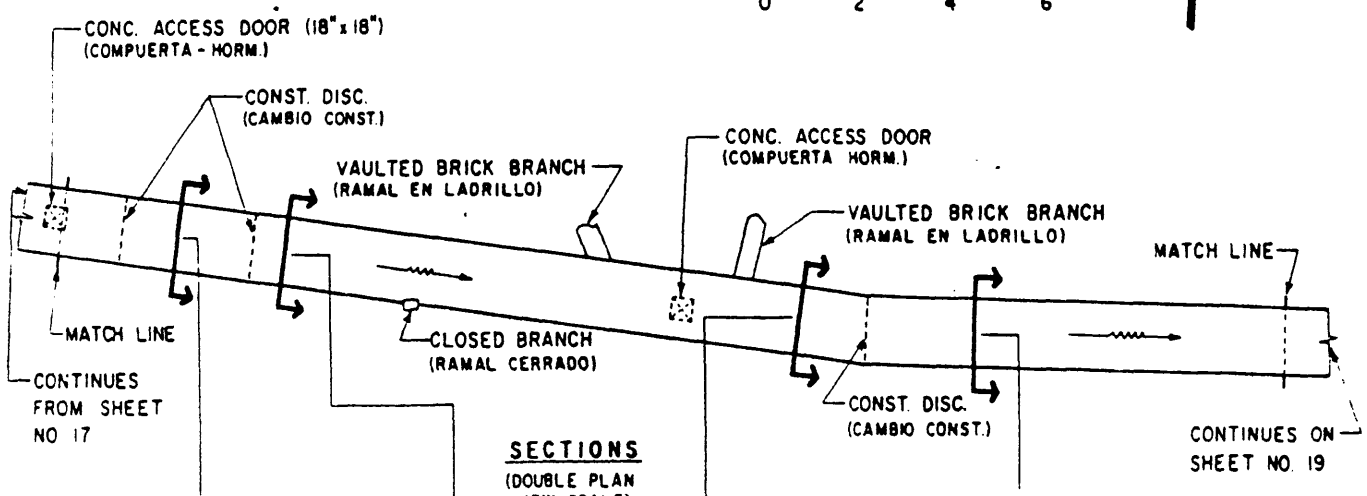
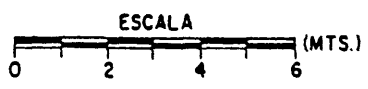
INTERIOR PROFILE VIEW

(HORIZONTAL NOT TO SCALE)

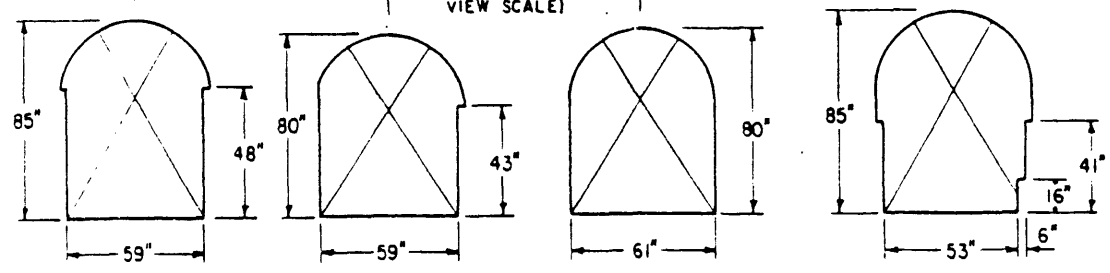


| | |
|--|-----------------------------|
| MANZANARES CREEK VAULTED
BRICK TUNNEL, - SAN GERMAN, P.R. | |
| WATER RESOURCES RESEARCH INSTITUTE
FACULTY OF ENGINEERING, U.P.R., MAYAGUEZ | |
| PRINCIPAL | DR. LUIS F. PUMARADA |
| INVESTIGATORS: | PROF. MIGUEL A. CRUZ AROCHO |
| SURVEY | ANGEL NOEL COLON GUZMAN |
| ASSISTANTS: | RAFAEL B. TORRES LOPATEGUI |
| HISTORICAL
RESEARCH: | EDWIN ALBINO |
| MAY-DECEMBER 1987 | |
| 17
30 | |

INTERIOR PLAN VIEW

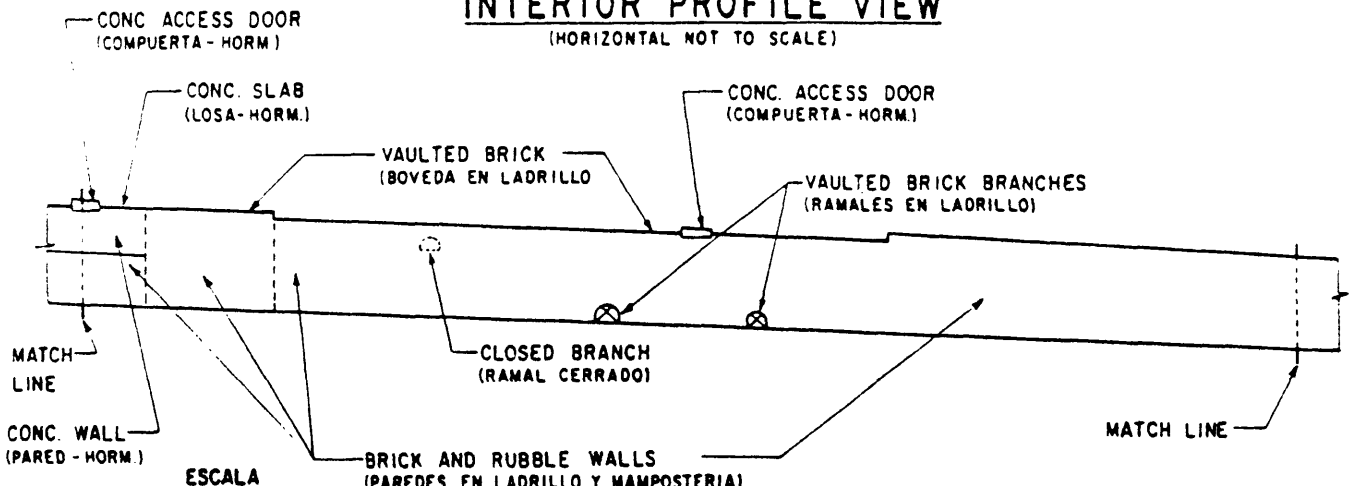


SECTIONS
(DOUBLE PLAN VIEW SCALE)



INTERIOR PROFILE VIEW

(HORIZONTAL NOT TO SCALE)

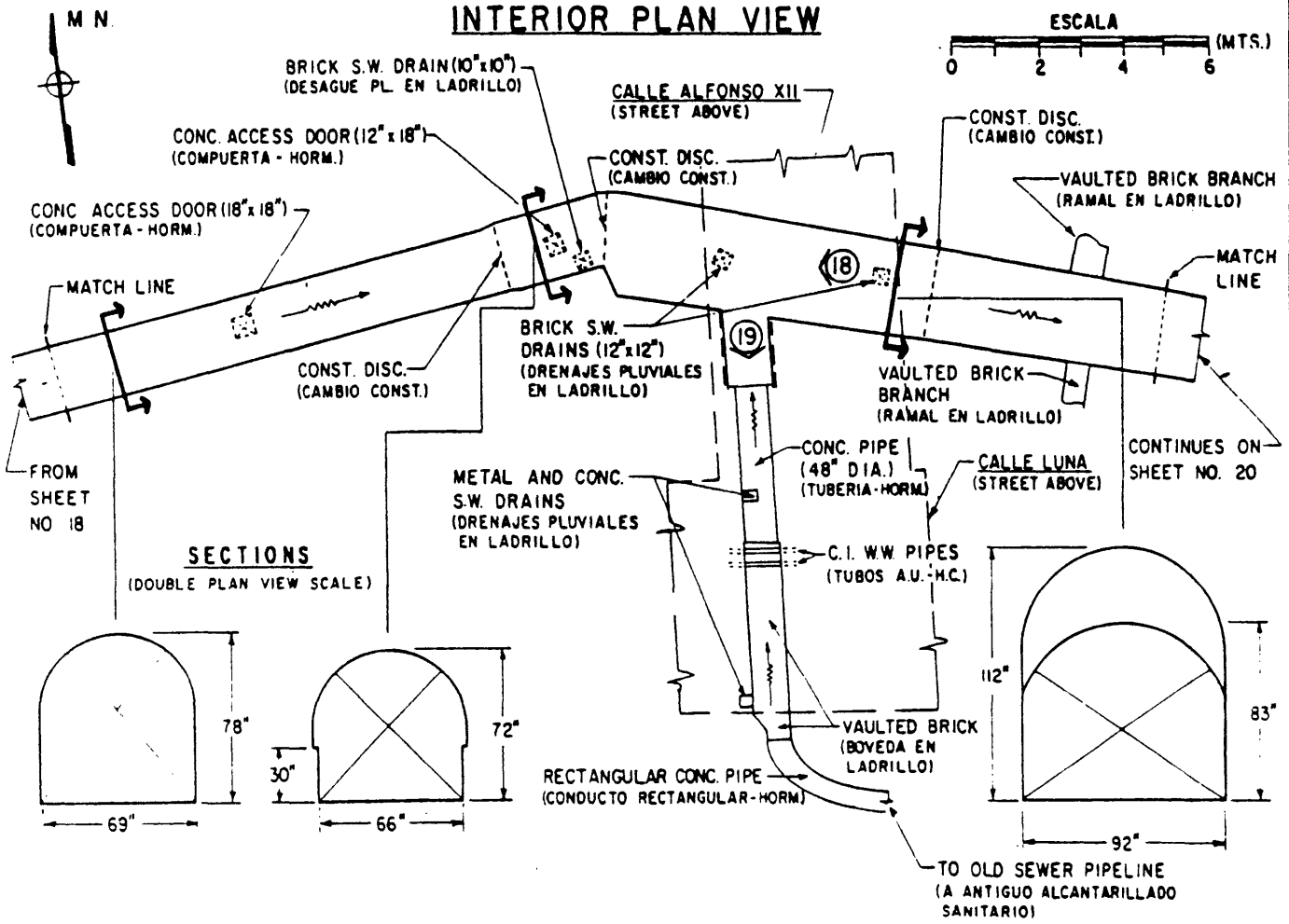


ESCALA
(MTS.)



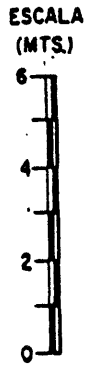
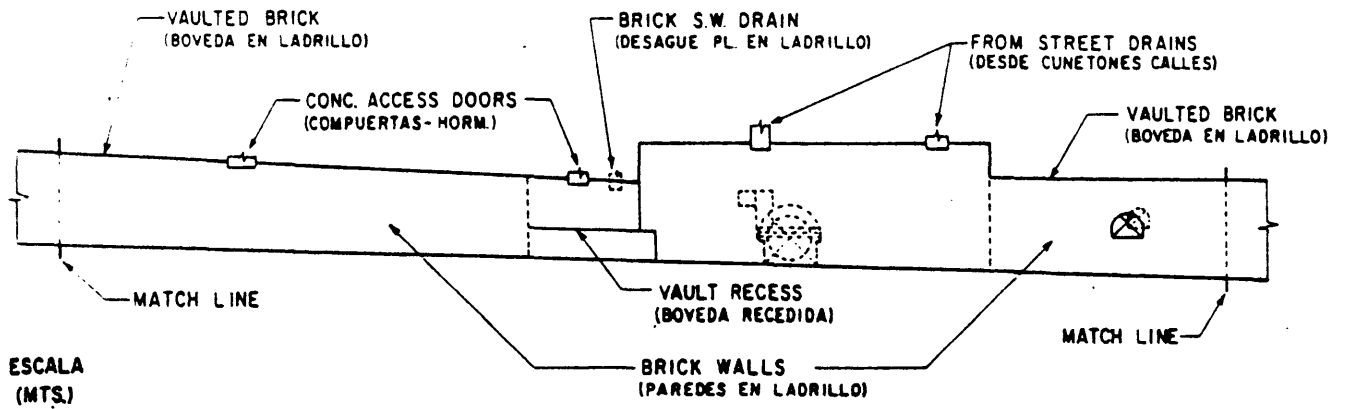
| | |
|--|-----------------------------|
| MANZANARES CREEK VAULTED BRICK TUNNEL, SAN GERMAN, P.R. | |
| WATER RESOURCES RESEARCH INSTITUTE
FACULTY OF ENGINEERING, U.P.R., MAYAGUEZ | |
| PRINCIPAL | DR. LUIS F. PUMARADA |
| INVESTIGATORS: | PROF. MIGUEL A. CRUZ AROCHO |
| SURVEY | ANGEL NOEL COLON GUZMAN |
| ASSISTANTS: | RAFAEL B. TORRES LOPATEGU |
| HISTORICAL RESEARCH: | EDWIN ALBINO |
| MAY-DECEMBER 1987 | |
| 18 | 30 |

INTERIOR PLAN VIEW



INTERIOR PROFILE VIEW

(HORIZONTAL NOT TO SCALE)

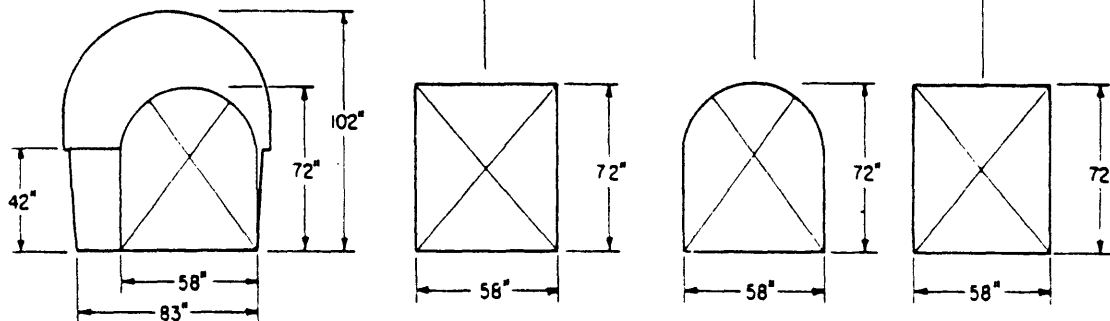
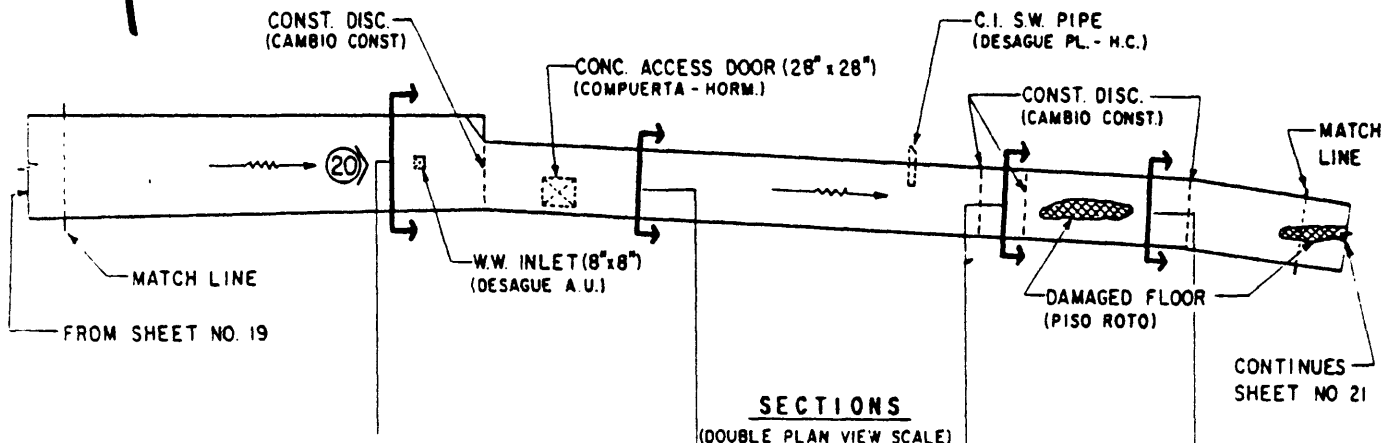
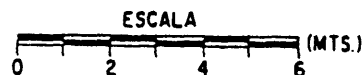


⑤ LOCATION AND DIRECTION OF CAMERA IN PHOTOGRAPH NO. 5

| | |
|--|-----------------------------|
| MANZANARES CREEK VAULTED BRICK TUNNEL, SAN GERMAN, P.R. | |
| WATER RESOURCES RESEARCH INSTITUTE
FACULTY OF ENGINEERING, U.P.R., MAYAGUEZ | |
| PRINCIPAL | DR. LUIS F. PUMARADA |
| INVESTIGATORS: | PROF. MIGUEL A. CRUZ AROCHO |
| SURVEY | ANGEL NOEL COLON GUZMAN |
| ASSISTANTS: | RAFAEL B. TORRES LOPATEGUI |
| HISTORICAL RESEARCH: | EDWIN ALBINO |
| MAY-DECEMBER 1987 | |

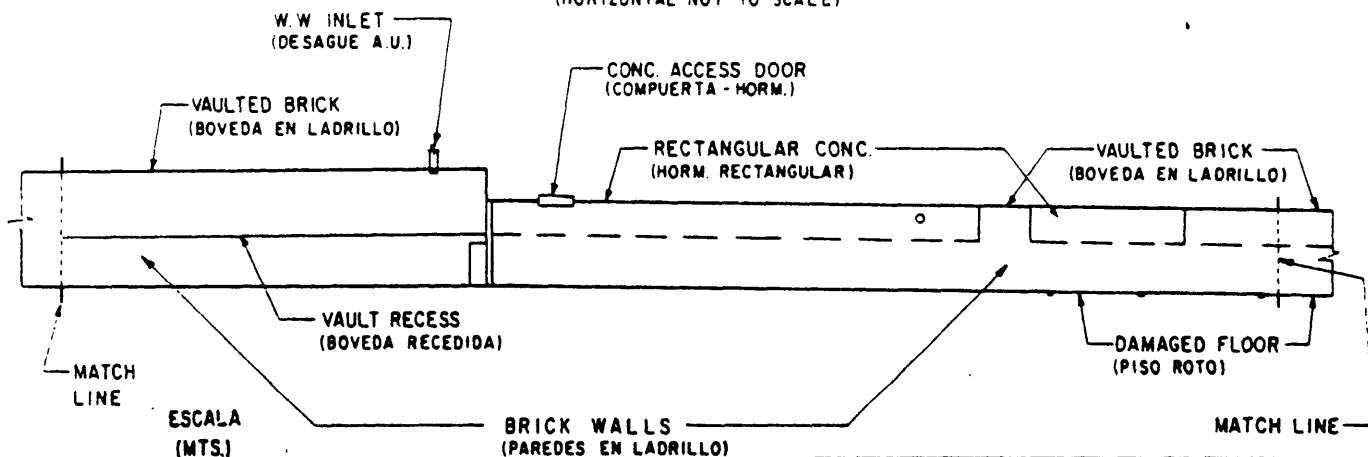


INTERIOR PLAN VIEW



INTERIOR PROFILE VIEW

(HORIZONTAL NOT TO SCALE)



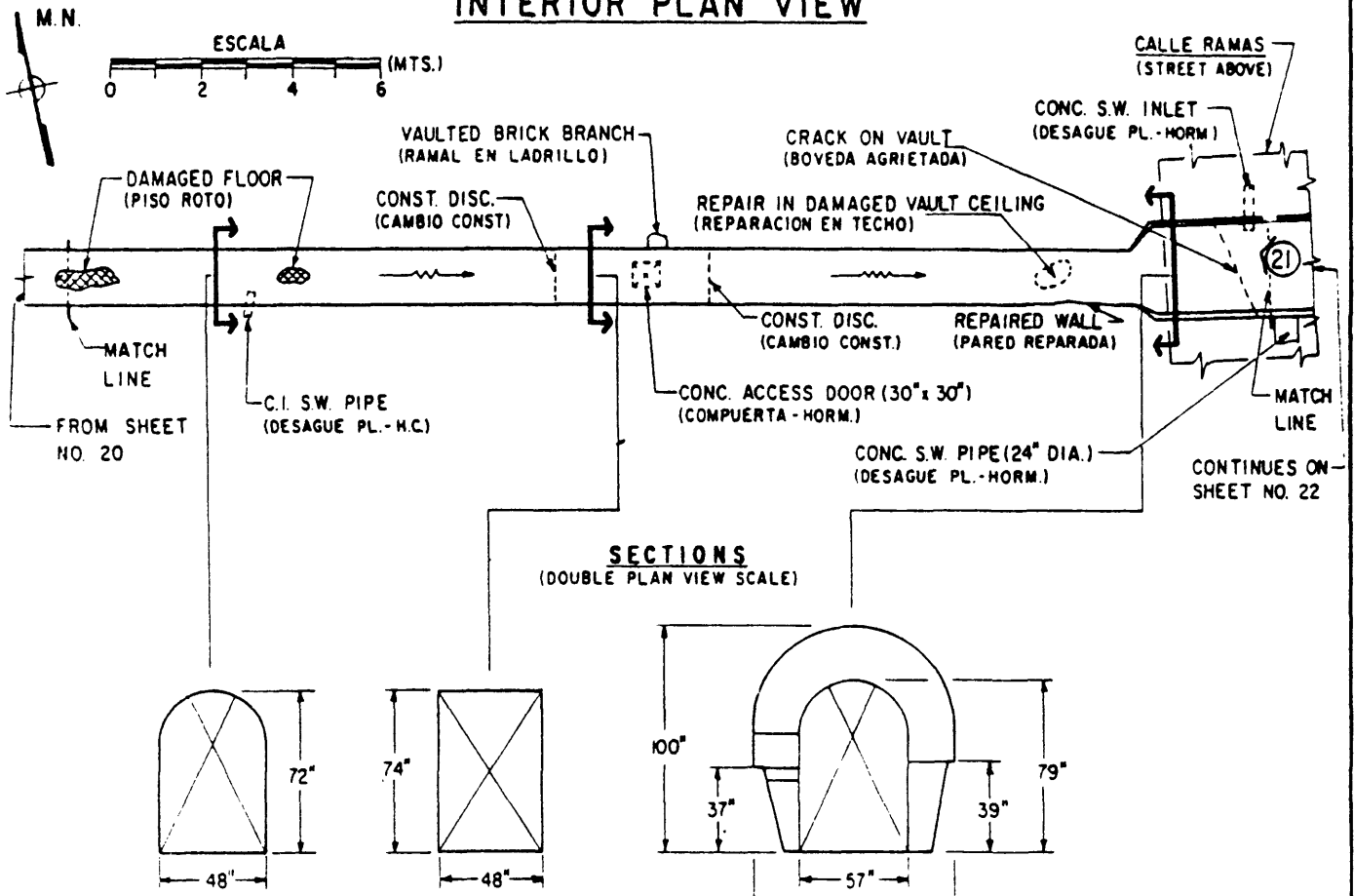
ESCALA (MTS.)



⑤ LOCATION AND DIRECTION OF CAMERA IN PHOTOGRAPH NO. 5

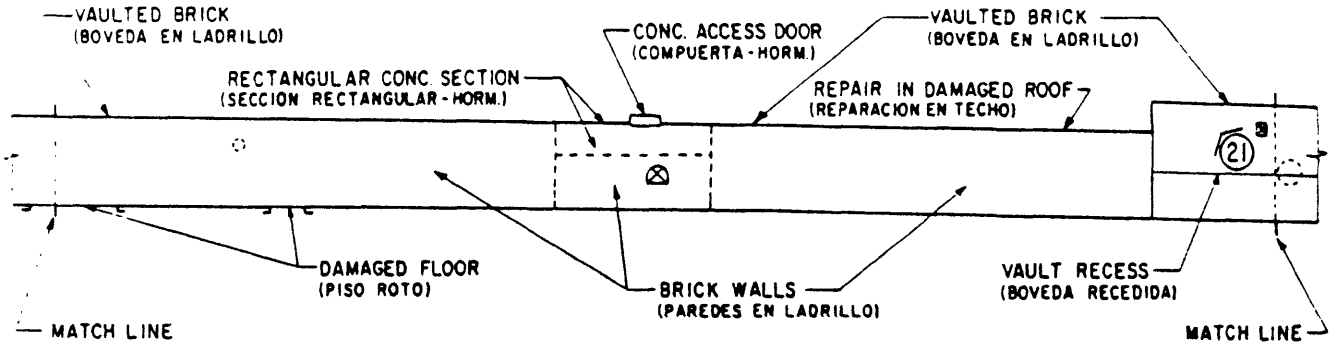
| | |
|--|-----------------------------|
| MANZANARES CREEK VAULTED BRICK TUNNEL, SAN GERMAN, P.R. | |
| WATER RESOURCES RESEARCH INSTITUTE
FACULTY OF ENGINEERING, U.P.R., MAYAGUEZ | |
| PRINCIPAL | DR. LUIS F. PUMARADA |
| INVESTIGATORS: | PROF. MIGUEL A. CRUZ AROCHO |
| SURVEY | ANGEL NOEL COLON GUZMAN |
| ASSISTANTS: | RAFAEL B. TORRES LOPATEGUI |
| HISTORICAL RESEARCH: | EDWIN ALBINO |
| MAY-DECEMBER 1987 | |
| 20 | 30 |

INTERIOR PLAN VIEW



INTERIOR PROFILE VIEW

(HORIZONTAL NOT TO SCALE)



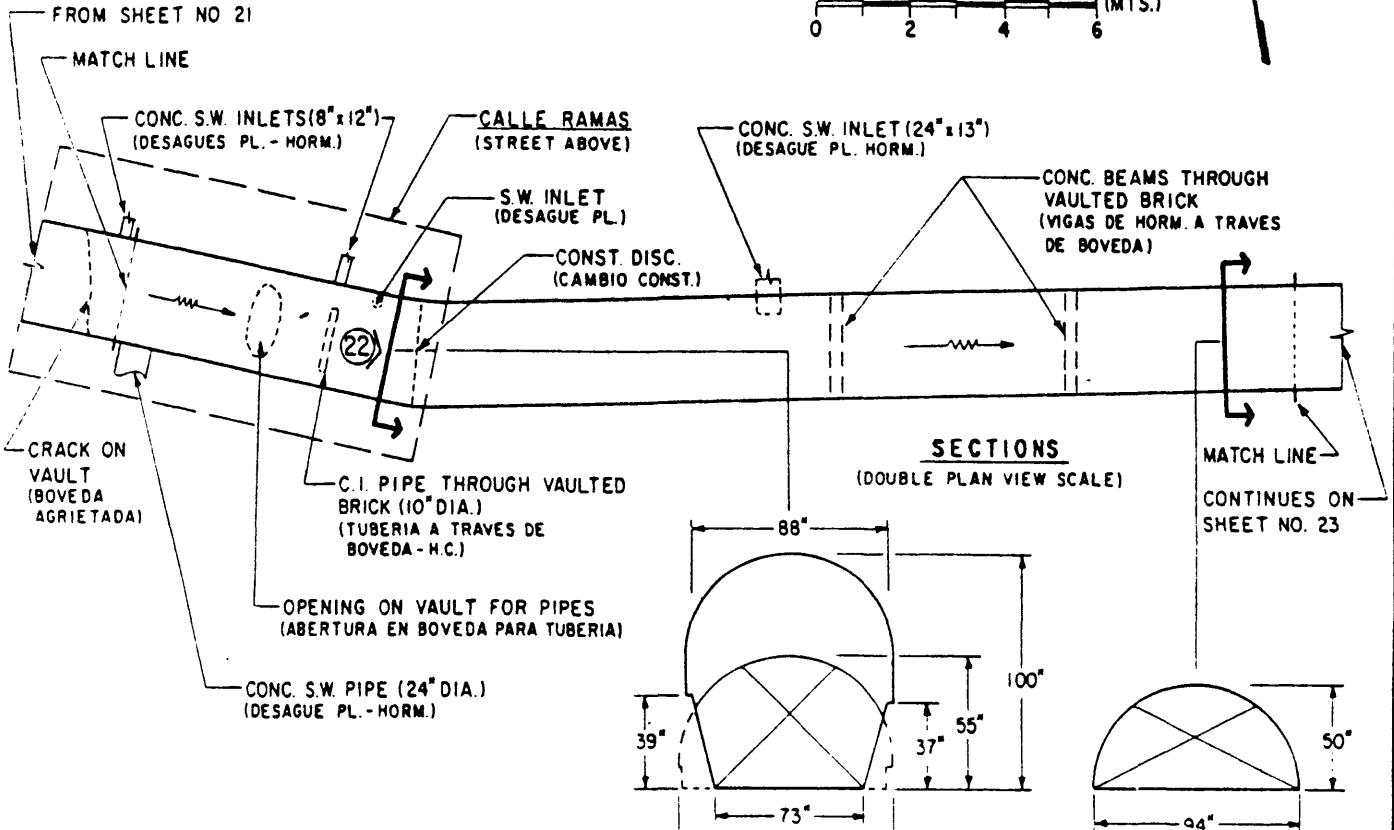
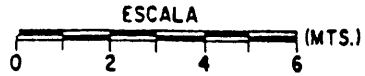
ESCALA (MTS.)



⑤ LOCATION AND DIRECTION OF CAMERA IN PHOTOGRAPH NO. 5

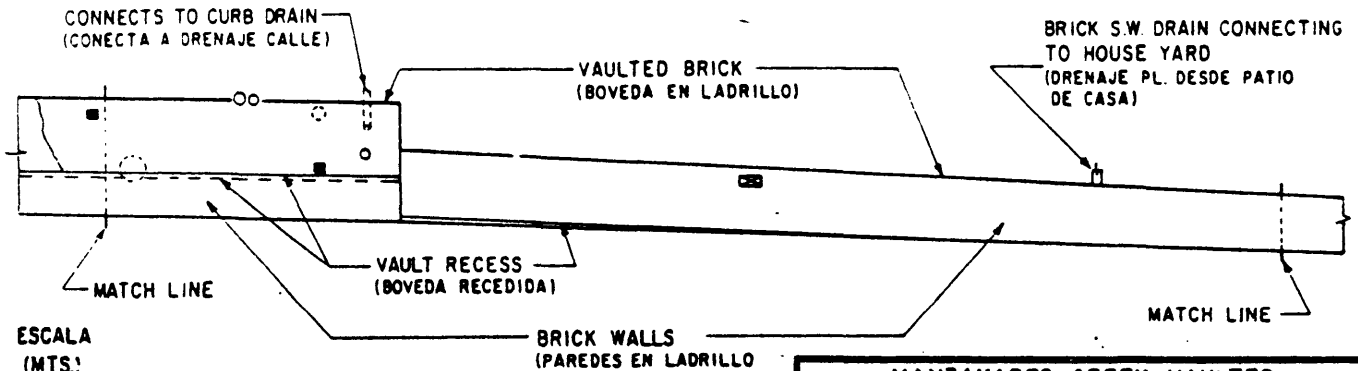
| | |
|--|---|
| MANZANARES CREEK VAULTED BRICK TUNNEL, SAN GERMAN, P.R. | |
| WATER RESOURCES RESEARCH INSTITUTE
FACULTY OF ENGINEERING, U.P.R., MAYAGUEZ | |
| PRINCIPAL: | DR. LUIS F. PUMARADA |
| INVESTIGATORS: | PROF. MIGUEL A. CRUZ AROCHO |
| SURVEY ASSISTANTS: | ANGEL NOEL COLON GUZMAN
RAFAEL B. TORRES LOPATEGUI |
| HISTORICAL RESEARCH: | EDWIN ALBINO |
| MAY-DECEMBER 1987 | |
| 21 | 30 |

INTERIOR PLAN VIEW



INTERIOR PROFILE VIEW

(HORIZONTAL NOT TO SCALE)



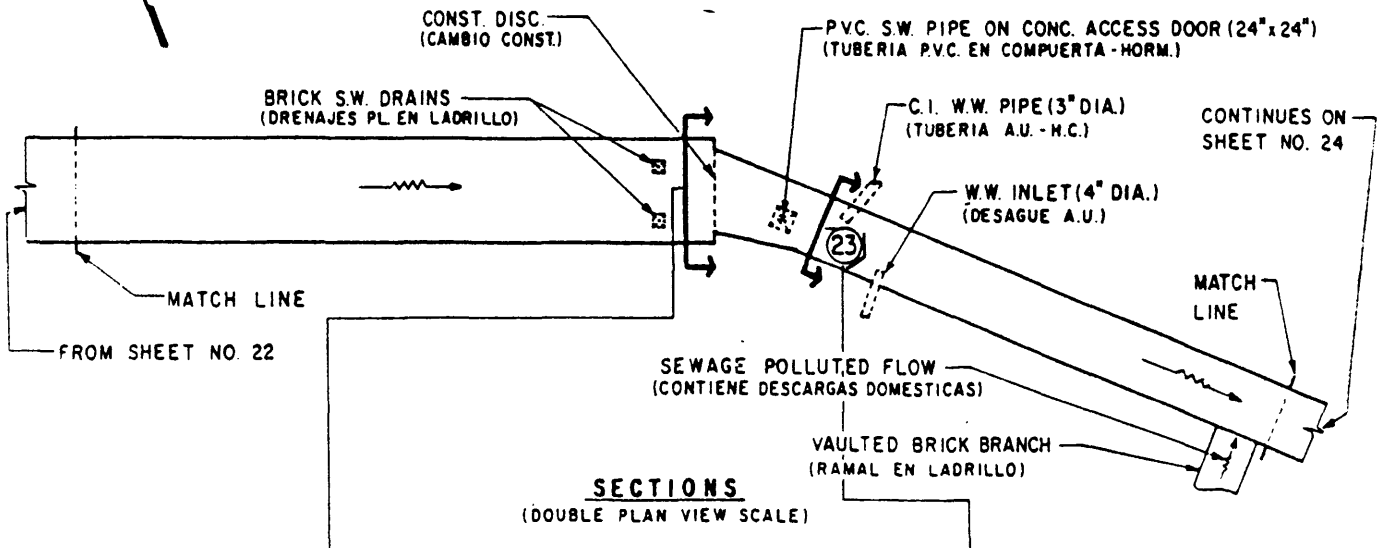
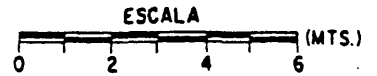
ESCALA (MTS.)



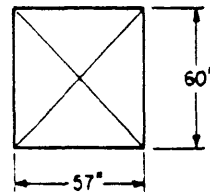
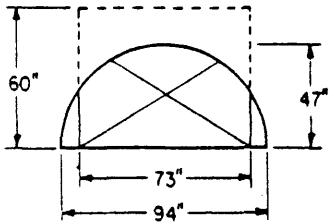
⑤ LOCATION AND DIRECTION OF CAMERA IN PHOTOGRAPH NO. 5

| | |
|--|-----------------------------|
| MANZANARES CREEK VAULTED BRICK TUNNEL, SAN GERMAN, P.R. | |
| WATER RESOURCES RESEARCH INSTITUTE
FACULTY OF ENGINEERING, U.P.R., MAYAGUEZ | |
| PRINCIPAL | DR. LUIS F. PUMARADA |
| INVESTIGATORS: | PROF. MIGUEL A. CRUZ AROCHO |
| SURVEY | ANGEL NOEL COLON GUZMAN |
| ASSISTANTS: | RAFAEL B. TORRES LOPATEGUI |
| HISTORICAL RESEARCH: | EDWIN ALBINO |
| MAY-DECEMBER 1987 | |
| | 22
30 |

INTERIOR PLAN VIEW

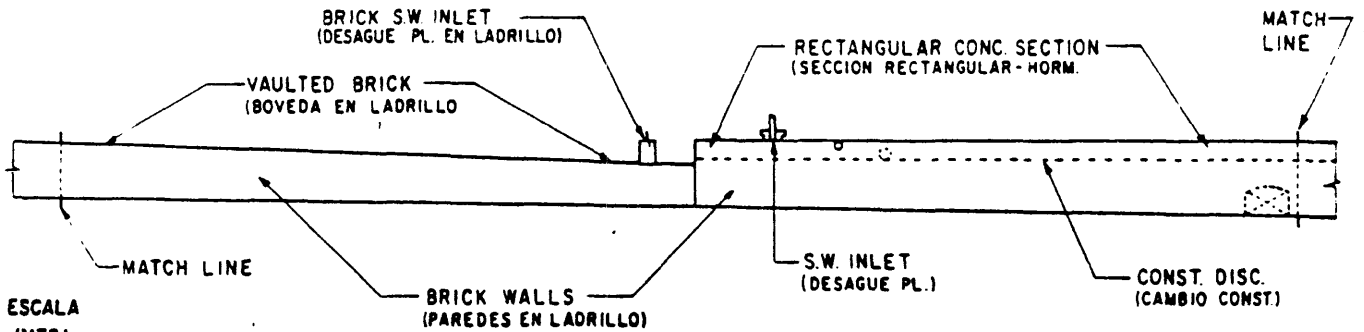


SECTIONS (DOUBLE PLAN VIEW SCALE)



INTERIOR PROFILE VIEW

(HORIZONTAL NOT TO SCALE)



ESCALA (MTS.)

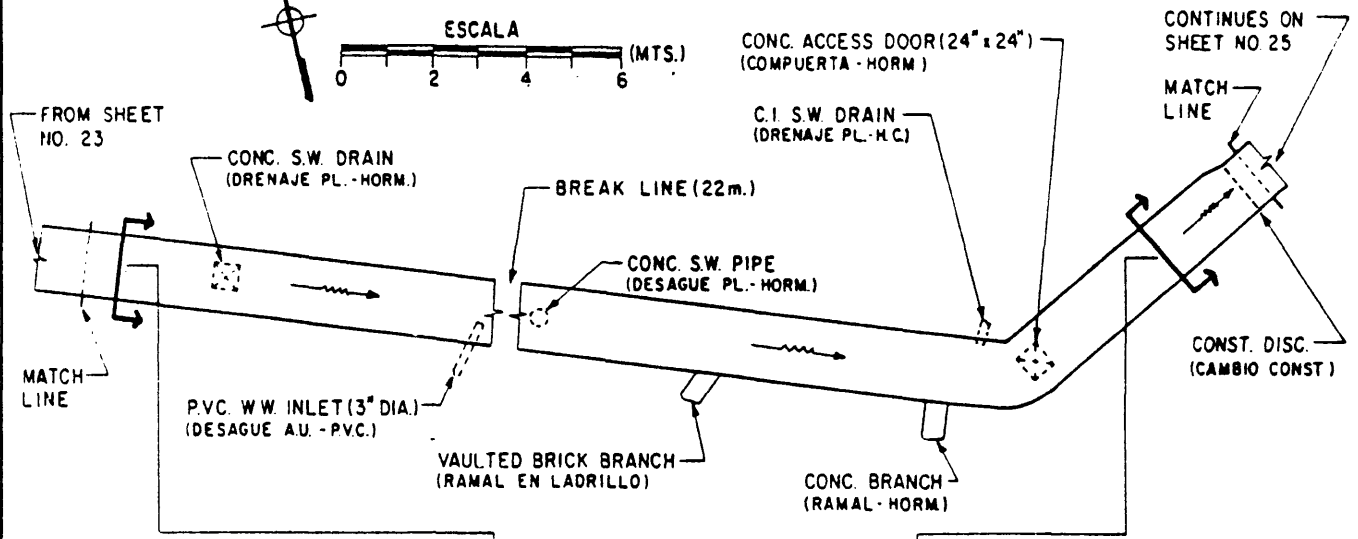
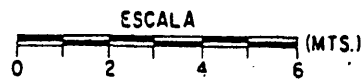


⑤ LOCATION AND DIRECTION OF CAMERA IN PHOTOGRAPH NO. 5

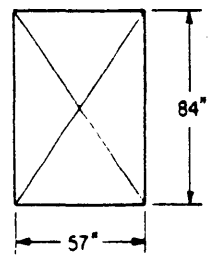
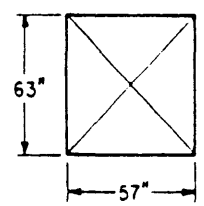
| | |
|--|-----------------------------|
| MANZANARES CREEK VAULTED
BRICK TUNNEL, SAN GERMAN, P.R. | |
| WATER RESOURCES RESEARCH INSTITUTE
FACULTY OF ENGINEERING, U.P.R., MAYAGUEZ | |
| PRINCIPAL | DR. LUIS F. PUMARADA |
| INVESTIGATORS: | PROF. MIGUEL A. CRUZ AROCHO |
| SURVEY | ANGEL NOEL COLON GUZMAN |
| ASSISTANTS: | RAFAEL B. TORRES LOPATEGUI |
| HISTORICAL
RESEARCH: | EDWIN ALBINC |
| MAY-DECEMBER 1987 | |
| | 23
30 |



INTERIOR PLAN VIEW

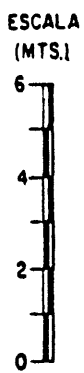
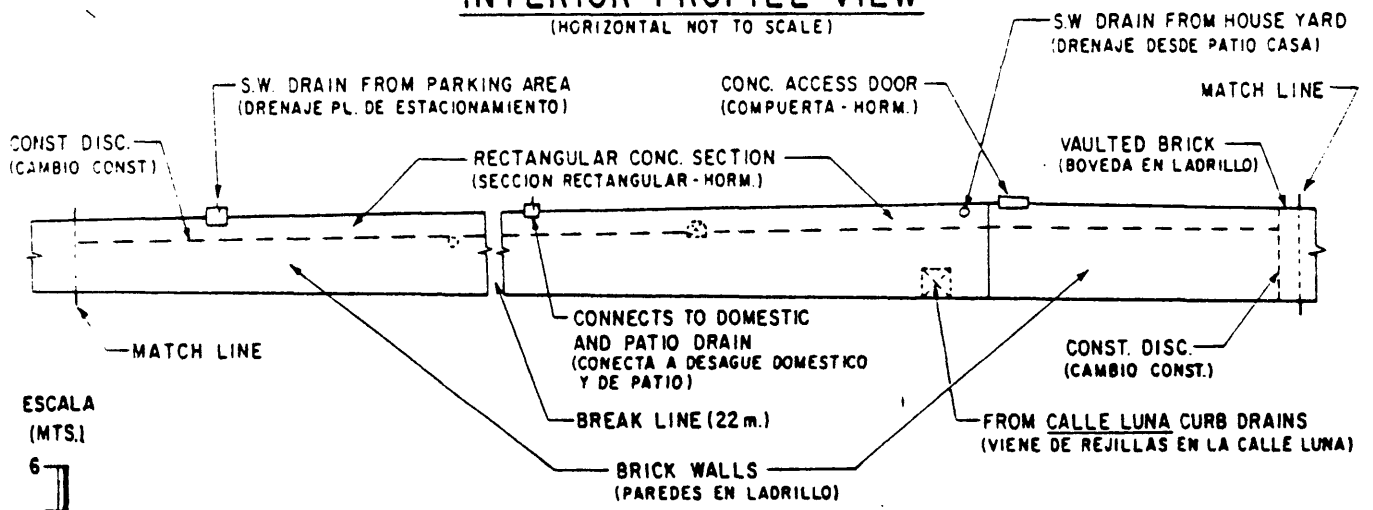


SECTIONS (DOUBLE PLAN VIEW SCALE)



INTERIOR PROFILE VIEW

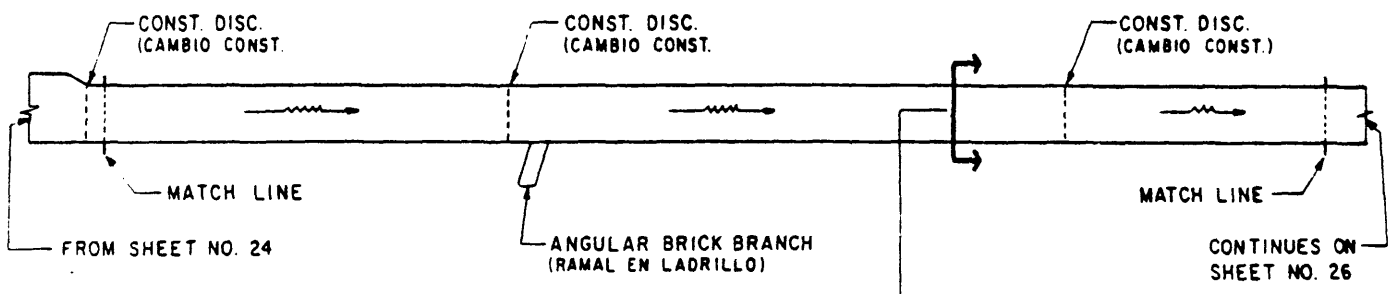
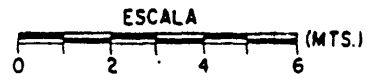
(HORIZONTAL NOT TO SCALE)



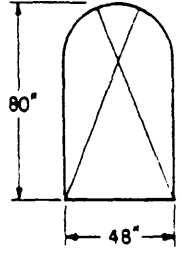
| | |
|--|-----------------------------|
| MANZANARES CREEK VAULTED BRICK TUNNEL, SAN GERMAN, P.R. | |
| WATER RESOURCES RESEARCH INSTITUTE
FACULTY OF ENGINEERING, U.P.R., MAYAGUEZ | |
| PRINCIPAL | DR. LUIS F. PUMARADA |
| INVESTIGATORS: | PROF. MIGUEL A. CRUZ AROCHO |
| SURVEY | ANGEL NOEL COLON GUZMAN |
| ASSISTANTS: | RAFAEL B. TORRES LOPATEGUI |
| HISTORICAL RESEARCH: | EDWIN ALBINO |
| MAY-DECEMBER 1987 | |
| 24 / 30 | |



INTERIOR PLAN VIEW

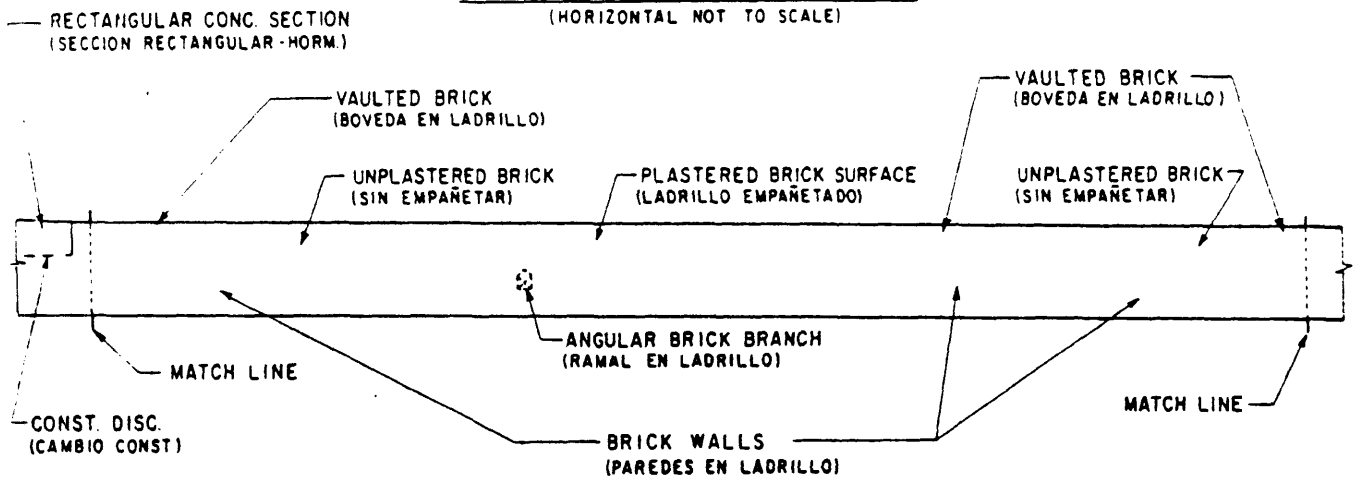


SECTION (DOUBLE PLAN VIEW SCALE)



INTERIOR PROFILE VIEW

(HORIZONTAL NOT TO SCALE)



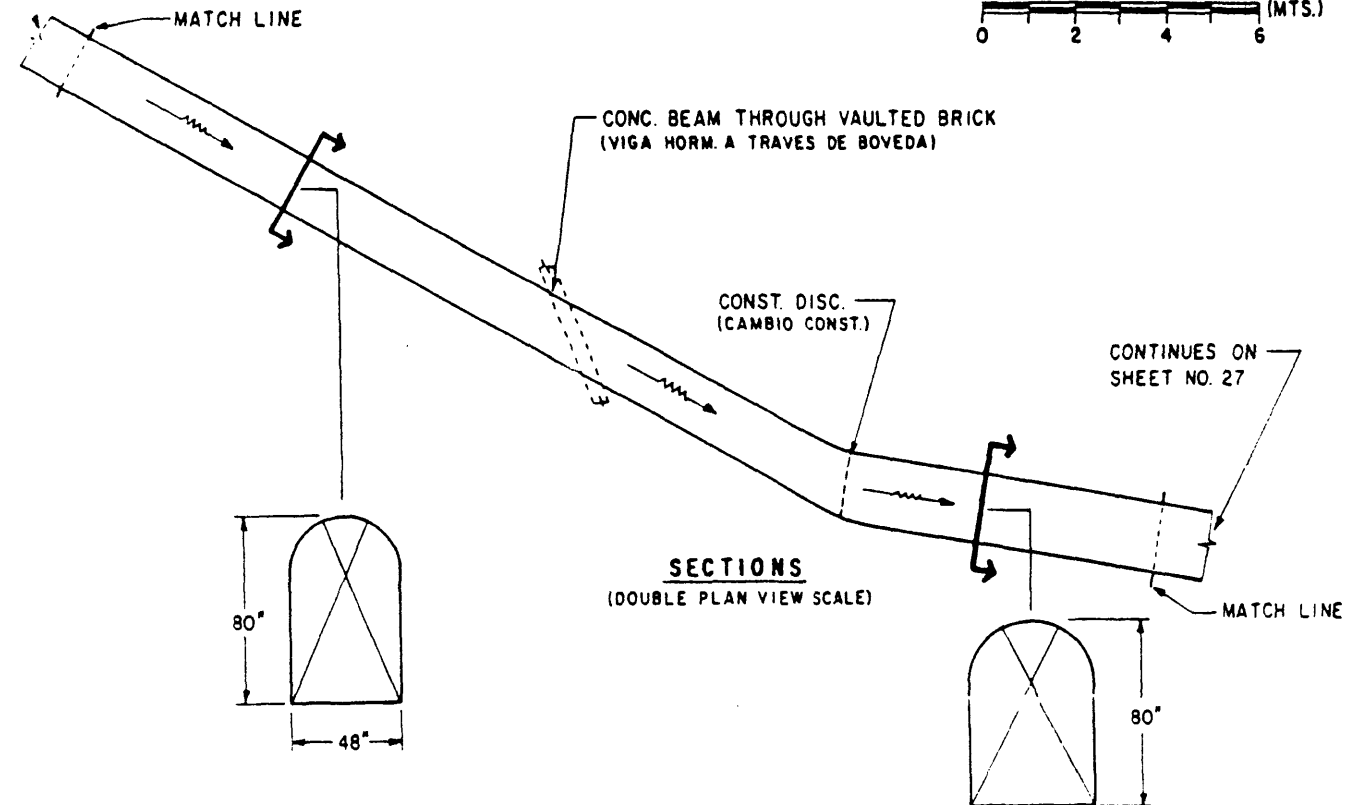
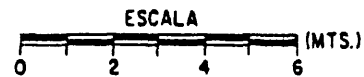
| | |
|--|-----------------------------|
| MANZANARES CREEK VAULTED
BRICK TUNNEL, SAN GERMAN, P.R. | |
| WATER RESOURCES RESEARCH INSTITUTE
FACULTY OF ENGINEERING, U.P.R., MAYAGUEZ | |
| PRINCIPAL | DR. LUIS F. PUMARADA |
| INVESTIGATORS: | PROF. MIGUEL A. CRUZ AROCHO |
| SURVEY | ANGEL NOEL COLON GUZMAN |
| ASSISTANTS: | RAFAEL B. TORRES LOPATEGUI |
| HISTORICAL
RESEARCH: | EDWIN ALBINO |
| MAY-DECEMBER 1987 | |
| | 25
30 |

INTERIOR PLAN VIEW

M.N.

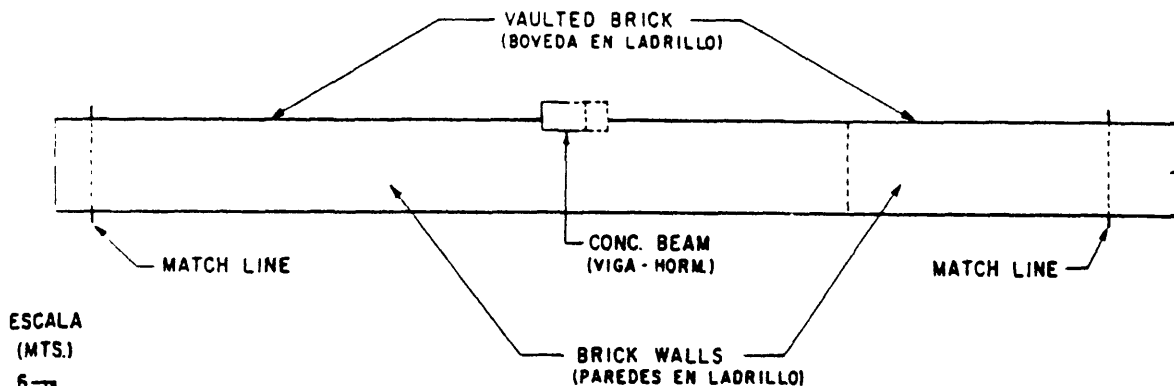


— FROM SHEET NO. 25



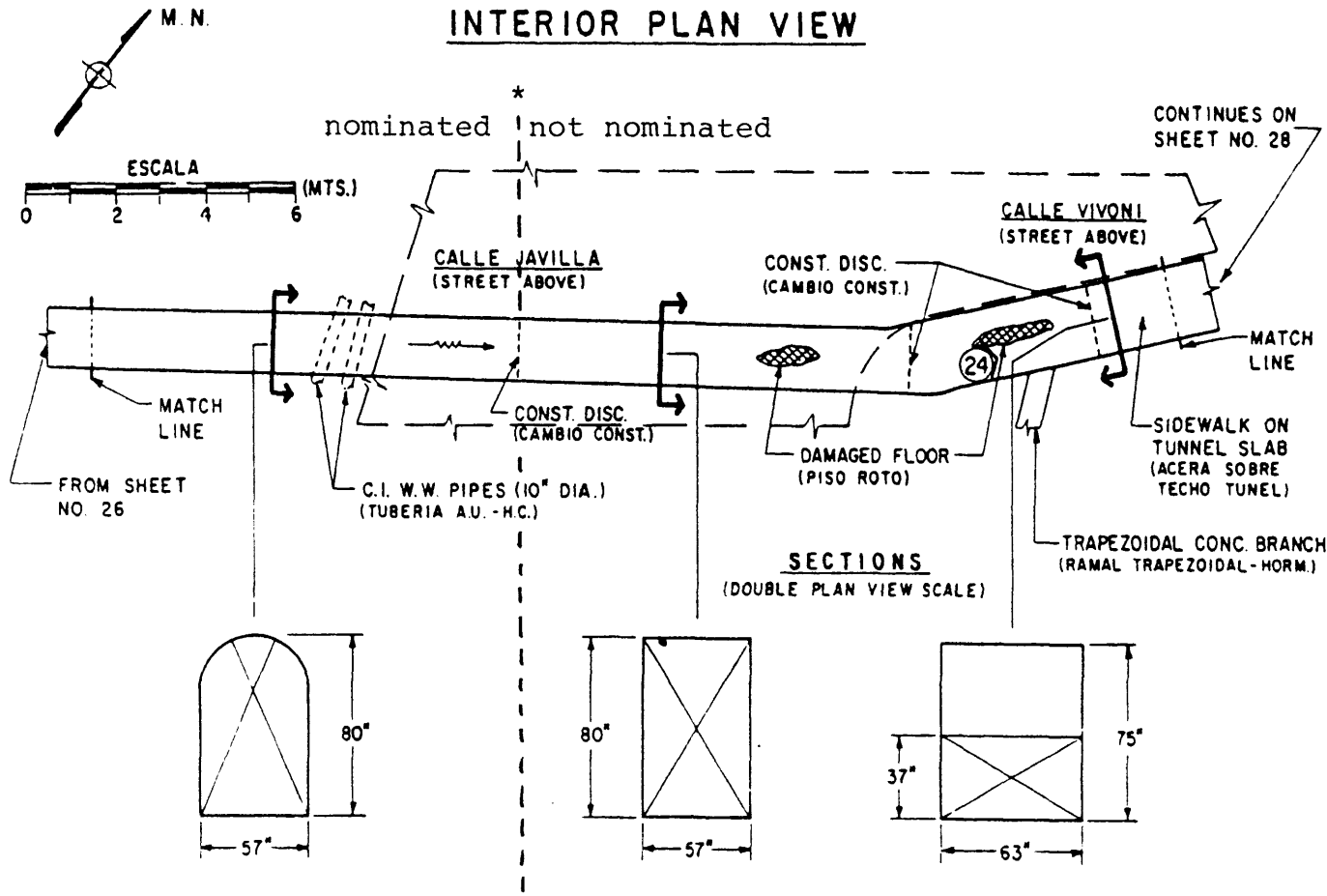
INTERIOR PROFILE VIEW

(HORIZONTAL NOT TO SCALE)



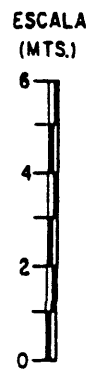
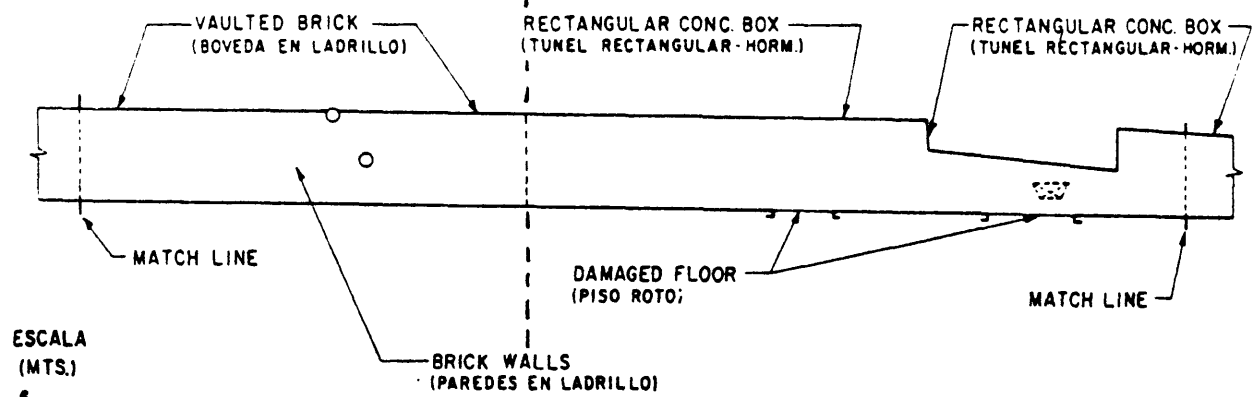
| | |
|--|-----------------------------|
| MANZANARES CREEK VAULTED
BRICK TUNNEL, SAN GERMAN, P.R. | |
| WATER RESOURCES RESEARCH INSTITUTE
FACULTY OF ENGINEERING, U.P.R., MAYAGUEZ | |
| PRINCIPAL | DR. LUIS F. PUMARADA |
| INVESTIGATORS: | PROF. MIGUEL A. CRUZ AROCHO |
| SURVEY | ANGEL NOEL COLON GUZMAN |
| ASSISTANTS: | RAFAEL B. TORRES LOPATEGUI |
| HISTORICAL
RESEARCH: | EDWIN ALBINO |
| MAY - DECEMBER 1987 | |
| 26 | 30 |

INTERIOR PLAN VIEW



INTERIOR PROFILE VIEW

(HORIZONTAL NOT TO SCALE)



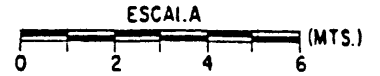
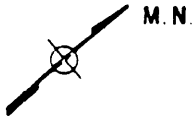
⑤ LOCATION AND DIRECTION OF CAMERA IN PHOTOGRAPH NO. 5

nominated | not nominated
* nominated

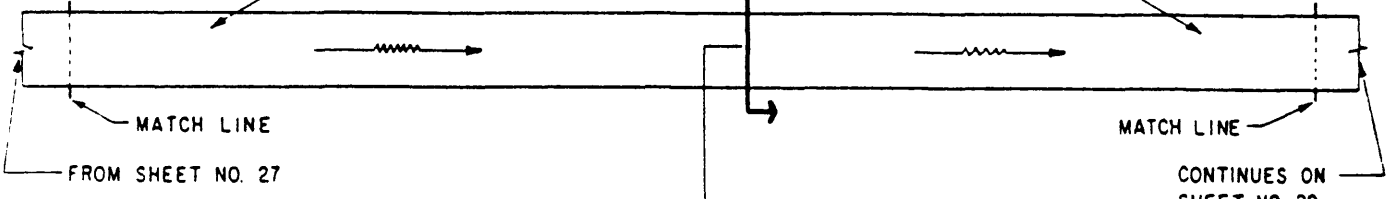
| | |
|--|-----------------------------|
| MANZANARES CREEK VAULTED BRICK TUNNEL, SAN GERMAN, P.R. | |
| WATER RESOURCES RESEARCH INSTITUTE
FACULTY OF ENGINEERING, U.P.R., MAYAGUEZ | |
| PRINCIPAL | DR. LUIS F. PUMARADA |
| INVESTIGATORS: | PROF. MIGUEL A. CRUZ AROCHO |
| SURVEY | ANGEL NOEL COLON GUZMAN |
| ASSISTANTS: | RAFAEL B. TORRES LOPATEGUI |
| HISTORICAL RESEARCH: | EDWIN ALBINO |
| MAY - DECEMBER, 1987 | |
| 27 | 30 |

* Tunnel sections north and east of this point are not being nominated.

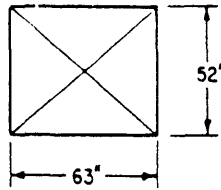
INTERIOR PLAN VIEW



SIDEWALK ON TUNNEL SLAB
(ACERA SOBRE TECHO TUNEL)



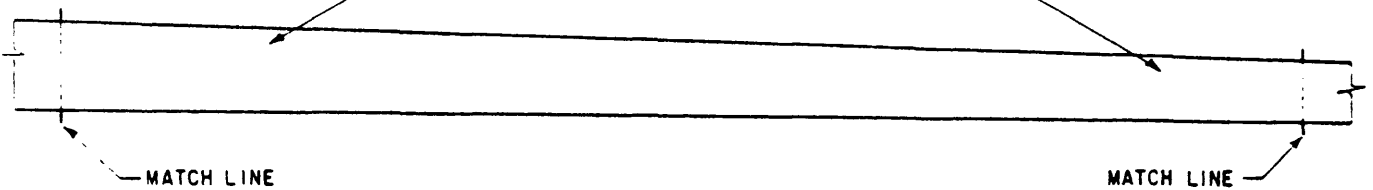
SECTION
(DOUBLE PLAN VIEW SCALE)



INTERIOR PROFILE VIEW

(HORIZONTAL NOT TO SCALE)

RECTANGULAR CONC. BOX
(TUNEL RECTANGULAR - HORM)



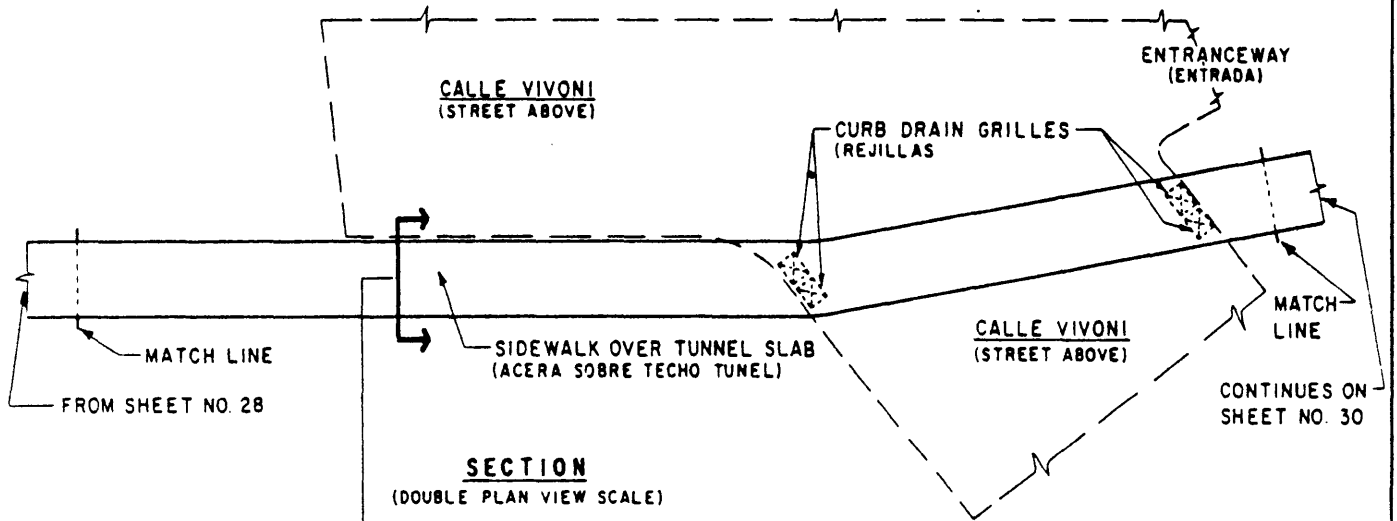
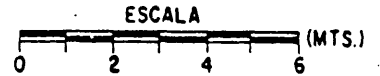
ESCALA
(MTS.)



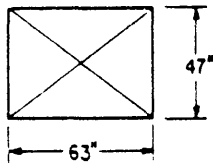
| | |
|--|-----------------------------|
| MANZANARES CREEK VAULTED
BRICK TUNNEL, SAN GERMAN, P.R. | |
| WATER RESOURCES RESEARCH INSTITUTE
FACULTY OF ENGINEERING, U.P.R., MAYAGUEZ | |
| PRINC'PAL | DR. LUIS F. PUMARADA |
| INVESTIGATORS: | PROF. MIGUEL A. CRUZ AROCHO |
| SURVEY | ANGEL NOEL COLON GUZMAN |
| ASSISTANTS: | RAFAEL B. TORRES LOPATEGUI |
| HISTORICAL
RESEARCH: | EDWIN ALBINO |
| MAY-DECEMBER 1987 | |
| 28 | 30 |

Note: This section of the tunnel system is not being nominated.

INTERIOR PLAN VIEW

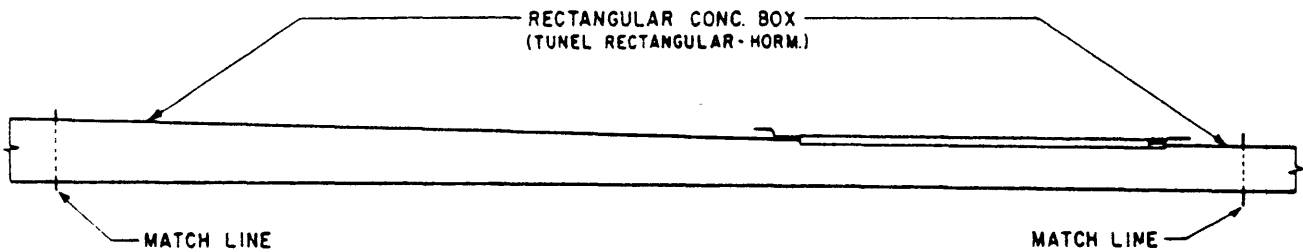


SECTION
(DOUBLE PLAN VIEW SCALE)



INTERIOR PROFILE VIEW

(HORIZONTAL NOT TO SCALE)



ESCALA
(MTS.)

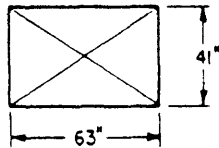
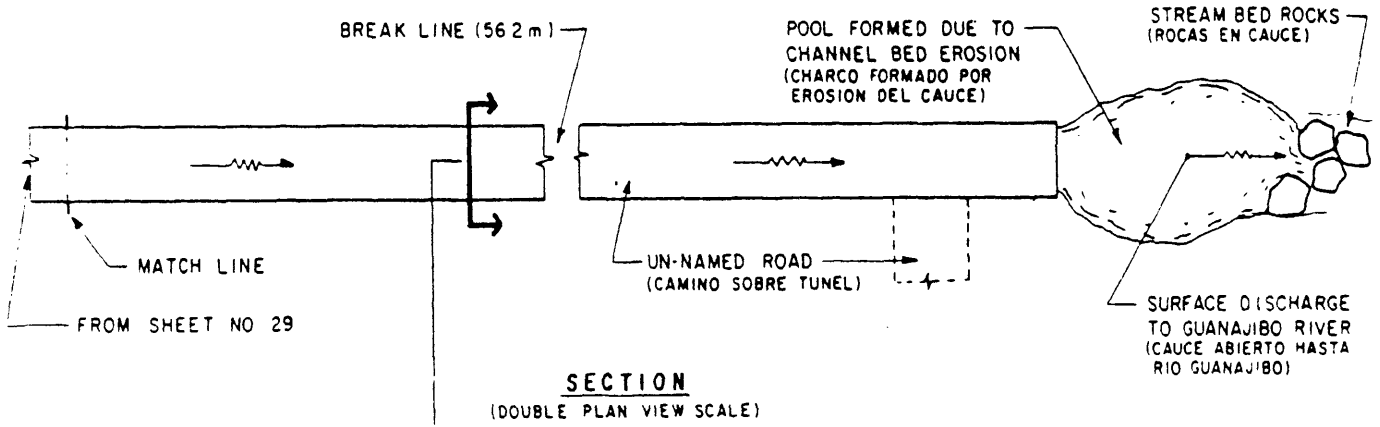
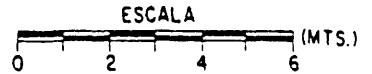


| | |
|--|-----------------------------|
| MANZANARES CREEK VAULTED
BRICK TUNNEL, SAN GERMAN, P.R. | |
| WATER RESOURCES RESEARCH INSTITUTE
FACULTY OF ENGINEERING, U.P.R., MAYAGUEZ | |
| PRINCIPAL | DR. LUIS F. PUMARADA |
| INVESTIGATORS: | PROF. MIGUEL A. CRUZ AROCHO |
| SURVEY | ANGEL NOEL COLON GUZMAN |
| ASSISTANTS: | RAFAEL B. TORRES LOPATEGUI |
| HISTORICAL
RESEARCH: | EDWIN ALBINO |
| MAY-DECEMBER 1987 | |
| 29 | 30 |

Note: This section of the tunnel system is not being nominated.

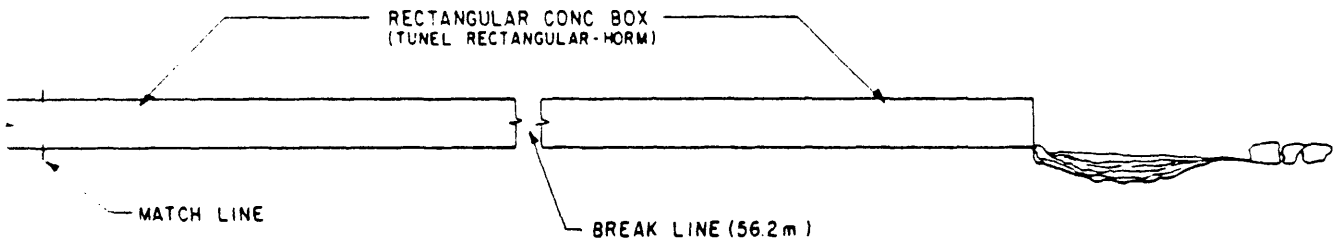


INTERIOR PLAN VIEW



INTERIOR PROFILE VIEW

(HORIZONTAL NOT TO SCALE)



ESCALA
(MTS.)



| | |
|--|----------------------------|
| MANZANARES CREEK VAULTED
BRICK TUNNEL, SAN GERMAN, P.R. | |
| WATER RESOURCES RESEARCH INSTITUTE
FACULTY OF ENGINEERING, U.P.R., MAYAGUEZ | |
| PRINCIPAL | DR. LUIS F. PUMARADA. |
| INVESTIGATORS: | ANGEL NOEL COLON GUZMAN |
| SURVEY | RAFAEL B. TORRES LOPATEGUI |
| ASSISTANTS: | EDWIN ALBINO |
| HISTORICAL
RESEARCH: | EDWIN ALBINO |
| MAY-DECEMBER 1987 | |
| 30 | 30 |

Note: This section of the tunnel system is not being nominated.