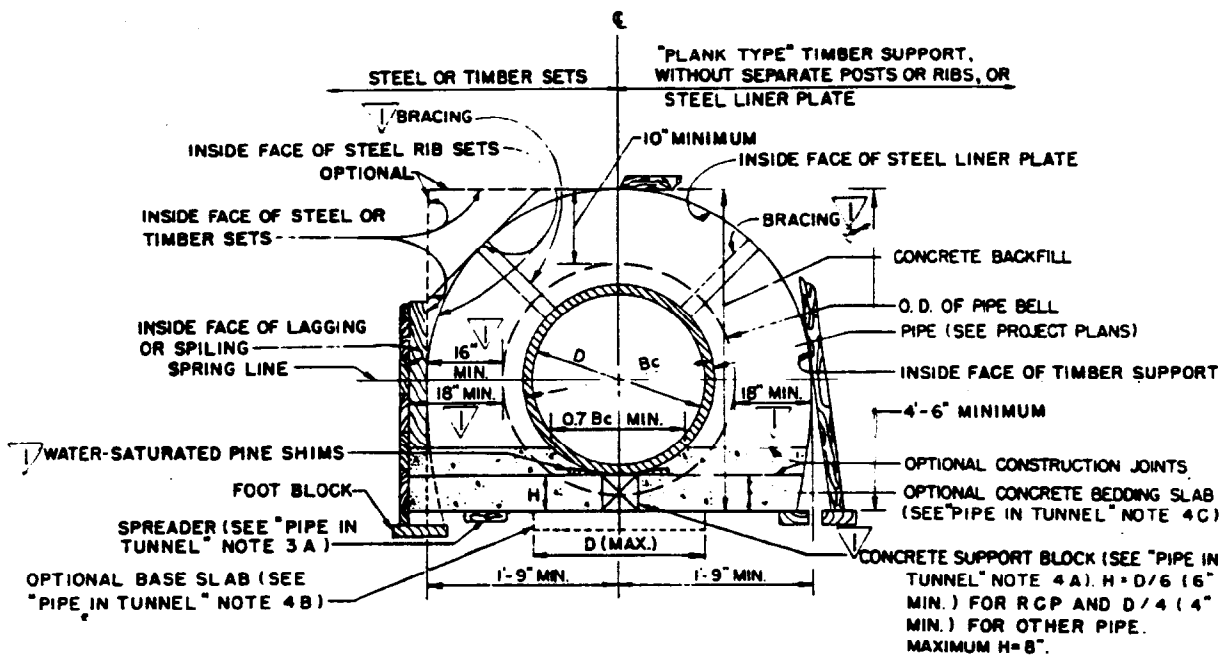


PIPE IN JACKED CASING
NOT TO SCALE



PIPE IN TUNNEL
NOT TO SCALE

BUREAU OF ENGINEERING

DEPARTMENT OF PUBLIC WORKS

CITY OF LOS ANGELES

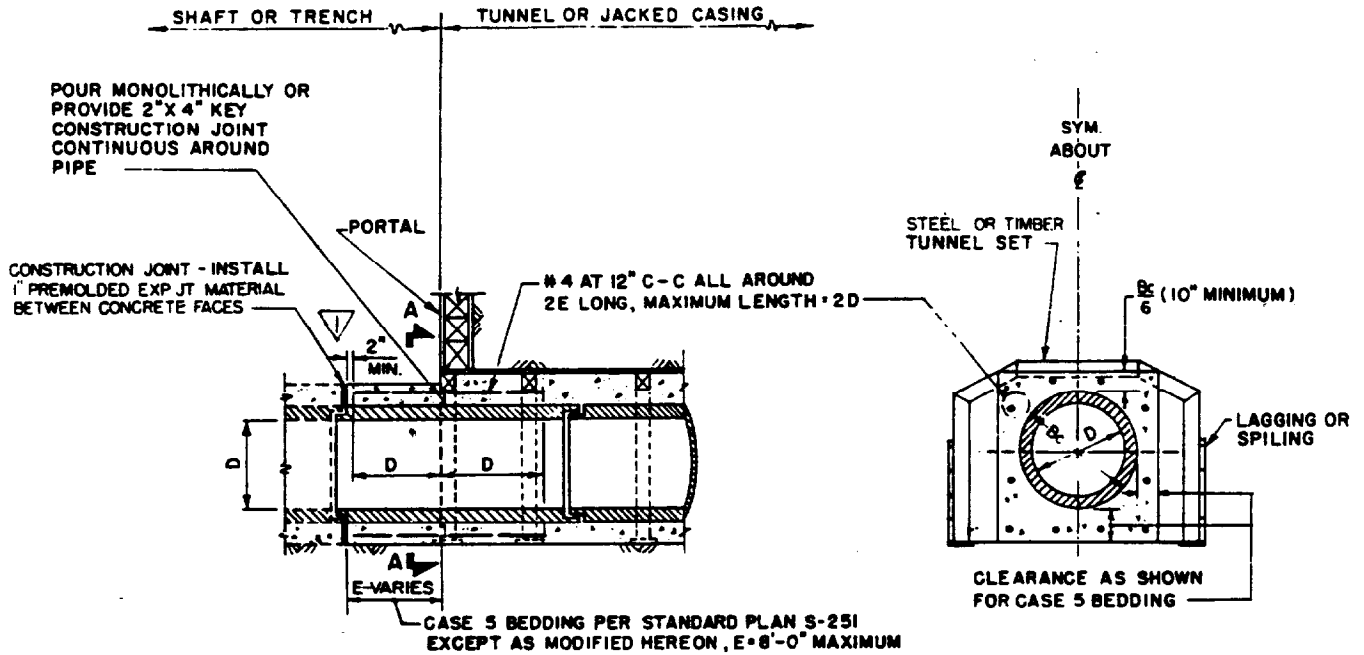
TUNNEL AND JACKED CASING DETAILS

STANDARD PLAN
S-254-1

SUBMITTED *[Signature]* 22 1992
ENGINEER OF DESIGN
[Signature]
DEPUTY ENGINEER
APPROVED *[Signature]* 21 1992
CITY ENGINEER
DESIGNED BY RGC DRAWN BY RGM CHECKED BY RGS



REVISIONS		SUPERSEDES	REFERENCES
NO	DESCRIPTION		
1	ADDED CONCRETE MIX ALTERNATIVE; INCREASED TUNNEL SIDE CLEARANCE; LIMITED MAXIMUM SIZE OF SUPPORT BLOCK; REMOVED NOTE; ADDED ALTERNATIVE FOR CONCRETE SUBBASE; CHANGED SURVEY SHAFT BACKFILL AND CASING REMOVAL LIMIT; REMOVED REFERENCE FOR CALCULATIONS; MADE GENERAL CLARIFICATIONS (SPELLING, ARROWHEADS).	B-3995	S-251
		VAULT INDEX NUMBER B-4108	
		SHEET 1 OF 5 SHEETS	

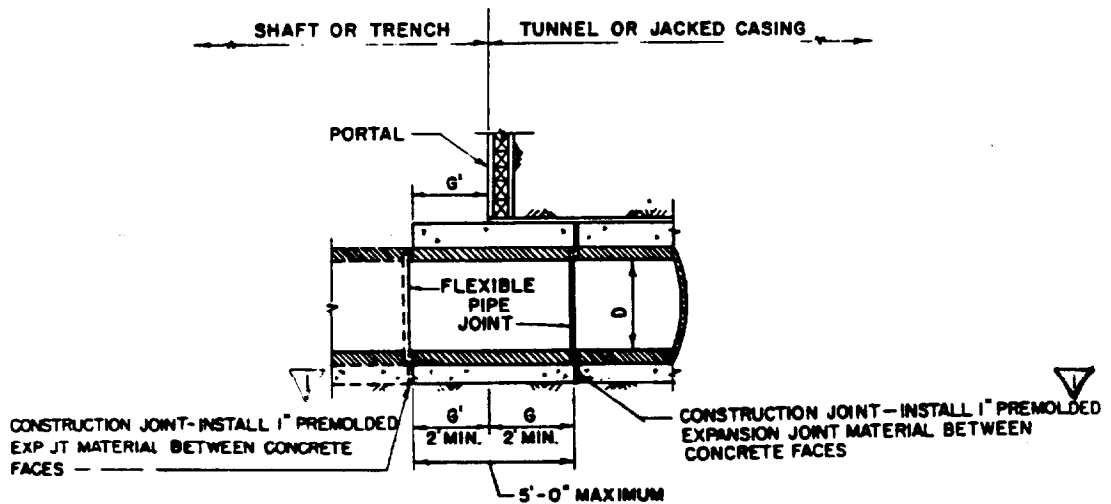


SECTION A-A

NOTES:

1. THE REINFORCEMENT SHALL BE PLACED 2" CLEAR FROM CONCRETE SURFACE, TUNNEL SETS OR JACKED CASING.
2. WHEN E IS LESS THAN 1'-0" NO REINFORCEMENT IS REQUIRED.

CASE A
(RCP)



NOTES:

THE CONCRETE SECTION WITHIN DIMENSION G' SHALL BE IDENTICAL TO EITHER THE TUNNEL OR THE JACKED CASING SECTION.

CASE B
(OTHER THAN RCP)
PIPE PROTECTION AT PORTALS

NOTES

- ▽ JACKED CASING AND TUNNEL CONSTRUCTION SHALL COMPLY WITH THE REQUIREMENTS OF APPLICABLE SECTIONS OF THE "STANDARD SPECIFICATIONS FOR PUBLIC WORKS CONSTRUCTION" EXCEPT AS NOTED HEREON. SHOP DRAWINGS SHALL INCLUDE METHODS OF TRANSPORTING PIPE IN CASING OR TUNNEL AND OF "TUGGING" PIPE INTO JOINT.

PIPE IN JACKED CASING NOTES

1. STRUCTURAL DESIGN REQUIREMENTS

JACKING PIT BRACING SHALL BE DESIGNED IN ACCORDANCE WITH THE TUNNEL SHAFT DESIGN REQUIREMENTS SET FORTH IN "PIPE IN TUNNEL NOTES" 2A(2) AND 2A(3) HEREON.

2. GROUTING

- A. GROUT FITTINGS AT THE CROWN OF THE CASING WILL BE REQUIRED FOR CASINGS WITH A DIAMETER OF 72 INCHES OR GREATER. SPACING SHALL BE 5 FEET CENTER-TO-CENTER, OFFSET 2.5 FEET FROM SIDE FITTINGS.
- B. AN APPROVED QUICK-ACTING VALVE SHALL BE USED AT EACH GROUT FITTING. THE VALVE MAY BE REMOVED WHEN BACKFLOW OF GROUT WILL NOT OCCUR.
- C. GROUTING WITH NEAT CEMENT SHALL BE DONE PRIOR TO THE INSTALLATION OF PIPE. GROUT SHALL BE PLACED THROUGH EACH FITTING AND SHALL BE APPLIED TO REFUSAL AT 10 PSI PRESSURE OR AS DIRECTED BY THE ENGINEER.

▽ 3. CONCRETE SUBBASE

THE CONCRETE SUBBASE SHALL BE CURED FOR 5 DAYS PRIOR TO THE APPLICATION OF LOADING. LOADS MAY BE APPLIED AFTER 24 HOURS IF 4 PINTS OF CALCIUM CHLORIDE PER SACK OF CEMENT ARE ADDED TO THE CONCRETE. OTHER ADMIXTURES MAY BE SUBMITTED TO THE ENGINEER FOR APPROVAL. (3-FOOT LONG REDWOOD SKIDS MAY BE USED AS AN ALTERNATE TO THE BLOCKS AND SUBBASE. THEY SHALL BE ATTACHED WITH STEEL BAND STRAPS SEPARATED BY 2 x 4 REDWOOD SPACERS.)

PIPE IN TUNNEL NOTES

1. SURVEY SHAFTS

- A. SURVEY SHAFTS SHALL BE CONSTRUCTED AT LOCATIONS SHOWN ON THE PLANS.
- B. COSTS FOR SHAFTS SHALL BE INCLUDED IN THE TUNNEL BID PRICE.
- C. THE SHAFTS SHALL BE PLUMB AND CENTERED OVER THE PIPE CENTER LINE AND SHALL EXTEND THROUGH THE TUNNEL SUPPORT. EACH SHAFT SHALL BE AT LEAST 12 INCHES IN DIAMETER, LINED WITH A SUITABLE STEEL CASING AND PROVIDED WITH A LOCKING COVER INSTALLED FLUSH WITH THE STREET SURFACE AND CAPABLE OF WITHSTANDING A LOAD OF 21,000 LBS.
- D. SHAFTS WHICH THE ENGINEER JUDGES UNUSABLE BECAUSE OF EXCESSIVE INCLINATION FROM A PLUMB LINE OR BECAUSE OF CAVING NOT PROPERLY CONTROLLED (IN THE CASING INSTALLATION) WILL NOT BE ACCEPTED. THE ENGINEER WILL ESTABLISH ALTERNATE LOCATIONS IN THE FIELD TO REPLACE THOSE SHAFTS WHICH ARE NOT ACCEPTABLE. SUCH ALTERNATE SHAFTS SHALL BE CONSTRUCTED BY THE CONTRACTOR AT NO ADDITIONAL COST TO THE CITY.
- ▽ E. WHEN THE SURVEY SHAFTS ARE NO LONGER NEEDED (AS DETERMINED BY THE ENGINEER) THE CONTRACTOR SHALL REMOVE THE STEEL CASINGS. THE CONTRACTOR SHALL REMOVE NOT LESS THAN THE UPPER 12 FEET OF CASING BELOW PAVEMENT SUBGRADE. THE CONTRACTOR SHALL THEN BACKFILL THE HOLE WITH A 1-SACK CEMENT-SAND SLURRY UP TO THE BOTTOM OF THE PAVEMENT SUBGRADE AND SHALL RESTORE THE SUBBASE AND PAVEMENT TO THEIR ORIGINAL TYPE AND THICKNESS.
- F. PAYMENT FOR SHAFTS NOT COMPLETED FOR USE BECAUSE OF SITE CONDITIONS BEYOND THE CONTRACTOR'S CONTROL WILL BE MADE IN ACCORDANCE WITH THE STIPULATED UNIT PRICE SCHEDULE.
- G. ALL CASINGS REMOVED FROM SHAFTS SHALL BECOME THE PROPERTY OF THE CONTRACTOR.
- H. SHAFTS LOCATED AT THE BEGINNING AND/OR END OF A TUNNEL SHALL NOT BE REGARDED AS SURVEY SHAFTS.

2. STRUCTURAL DESIGN REQUIREMENTS

A. TUNNEL SUPPORTS AND TUNNEL SHAFT BRACING SHALL BE DESIGNED IN ACCORDANCE WITH THE FOLLOWING MINIMUM CRITERIA:

(1) TUNNEL SUPPORT DESIGN

(A) THE CONTRACTOR SHALL PROVIDE TUNNEL SUPPORTS CAPABLE OF WITHSTANDING ALL SUPERIMPOSED LOADS WHICH MAY EXIST, OR WHICH MAY ARISE DURING THE CONSTRUCTION OF THE PROJECT, INCLUDING ANY LOADS THAT MAY BE ANTICIPATED. MINIMUM EARTH LOADS SHALL BE DETERMINED BY THE FOLLOWING CRITERIA:

$$P = 0.30W (0.50Z + C) \text{ AND}$$

$C' = CW$ WHERE:

$P =$ AVERAGE UNIT HORIZONTAL EARTH PRESSURE (PSF).

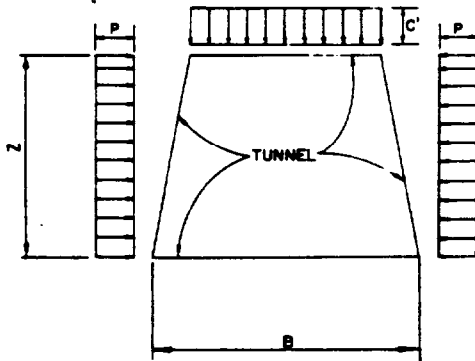
$C' =$ AVERAGE UNIT VERTICAL PRESSURE (PSF).

$W =$ UNIT WEIGHT OF SOIL (110 PCF UNLESS OTHERWISE NOTED).

$Z =$ MAXIMUM HEIGHT OF TUNNEL EXCAVATION (FT.).

$C =$ EQUIVALENT HEIGHT OF EARTH LOADING ON TUNNEL SUPPORTS (FT.) $= 0.30 (B+Z)$.

$B =$ MAXIMUM WIDTH OF TUNNEL EXCAVATION (FT.).



(B) VALUES OF C SHALL BE DOUBLED WHEN THE TUNNEL IS CONSTRUCTED BELOW THE WATER TABLE. WHERE THE EARTH COVER (THE DISTANCE FROM THE TOP OF THE TUNNEL SUPPORTS TO THE GROUND SURFACE) IS LESS THAN 8 FEET OR $2C$, AS DETERMINED BY THE ABOVE FORMULA, THE FULL HEIGHT OF EARTH COVER SHALL BE USED IN LIEU OF THE VALUE OF C . UNDER RAILROAD TRACKS THE VALUES OF C AS DETERMINED IN (A) ABOVE SHALL BE TRIPLED, BUT NEED NOT EXCEED THE ACTUAL EARTH COVER.

(C) IN ADDITION TO THE DEAD LOADS INDICATED ABOVE, CONSIDERATION SHALL BE GIVEN TO THE EFFECT OF ANY LIVE LOADS. HIGHWAY LIVE LOADS SHALL BE H20 LOADING PLUS IMPACT, BUT MAY BE NEGLECTED WHERE THE COVER EXCEEDS 8 FEET. RAILROAD LIVE LOADS SHALL BE AS REQUIRED BY THE AMERICAN RAILWAY ENGINEERING ASSOCIATION'S "MANUAL FOR RAILWAY ENGINEERING".

(2) TUNNEL SHAFT DESIGN

(A) TUNNEL SHAFT BRACING SHALL BE DESIGNED FOR THE LATERAL EARTH PRESSURES REPRESENTED BY THE FOLLOWING DIAGRAM WHICH INCLUDES THE EFFECT OF A SURCHARGE DUE TO AN ADJACENT H2O LOADING:

$P = KD =$ UNIT HORIZONTAL PRESSURE IN (PSF) WHERE:

$D =$ DEPTH OF EXCAVATION (FT.)

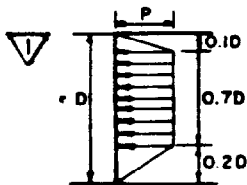
$K =$ COEFFICIENT DEPENDING UPON SOIL CONDITIONS

VALUES OF COEFFICIENT K :

$= 23$ FOR ALL SOILS EXCEPT WET SAND, SATURATED SOIL, OR SOFT PLASTIC CLAY

$= 46$ FOR WET SAND

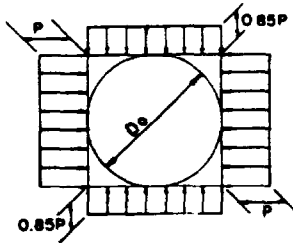
$= 92$ FOR SATURATED SOIL OR SOFT PLASTIC CLAY



2. STRUCTURAL DESIGN REQUIREMENTS

A. (2) (CONTINUED)

- (b) THE RING OF CYLINDRICAL SHAFTS SHALL BE DESIGNED FOR THE NON-UNIFORM LATERAL EARTH PRESSURES SHOWN BELOW:



$P = KD$ = UNIT HORIZONTAL PRESSURE IN PSF (SEE 2.A.(2)(A))

D_o = OUTSIDE DIAMETER OF SHAFT

- ▽ THE COEFFICIENTS FOR MOMENT AND THRUST CALCULATIONS SHALL BE FROM RECOGNIZED AND ACCEPTABLE THEORIES.

(3) ALLOWABLE UNIT STRESSES:

THE FOLLOWING ALLOWABLE UNIT STRESSES SHALL BE USED IN THE DESIGN OF TUNNEL SUPPORTS AND TUNNEL SHAFT BRACING.

- (A) STRUCTURAL STEEL STRESSES SHALL NOT EXCEED THOSE SPECIFIED IN THE MANUAL OF STEEL CONSTRUCTION AS PUBLISHED BY AISC. USED STEEL OF STEEL OF UNKNOWN ORIGIN SHALL HAVE ALLOWABLE DESIGN STRESSES NOT EXCEEDING 80 PERCENT OF THOSE SPECIFIED FOR ASTM A36.
- (B) TIMBER STRESSES SHALL NOT EXCEED THE WEST COAST LUMBER INSPECTION BUREAU'S OR WESTERN WOOD PRODUCTS ASSOCIATION'S BASIC VALUES, EXCEPT THAT ALLOWABLE STRESSES MAY BE INCREASED 25 PERCENT FOR TEMPORARY LOADING.

3. TIMBER SUPPORTS

- A. SPREADERS SHALL BE REQUIRED WHEN FOUND NECESSARY TO RESIST LATERAL LOADS. MOREOVER, THE ENGINEER MAY REQUIRE SPREADERS AS A CONDITION FOR APPROVAL OF THE CONTRACTOR'S PROPOSED TUNNEL SUPPORT METHOD.
- B. "PLANK TYPE" TIMBER SUPPORTS WITHOUT SEPARATE POSTS OR RIBS WILL NOT BE PERMITTED IN TUNNELS FOR PIPES WITH AN INSIDE DIAMETER OF 45 INCHES OR GREATER.

4. SUPPORT BLOCKS

- A. SUPPORT BLOCKS SHALL BE PLACED UNDER ALL CLAY PIPE AND BELL AND SPIGOT RCP. A SUFFICIENT NUMBER OF BLOCKS SHALL BE USED TO PREVENT ANY SETTLEMENT.
- ▽ B. THE CONTRACTOR MAY INSTALL, AT ITS EXPENSE, AN OPTIONAL CONCRETE BASE SLAB TO PROVIDE ADEQUATE SUPPORT FOR BLOCKS. THE REQUIREMENTS FOR LOADING SHALL BE AS SPECIFIED FOR THE CONCRETE SUBBASE IN "PIPE IN JACKED CASING" NOTE 3.
- C. THE CONTRACTOR MAY INSTALL AN OPTIONAL CONCRETE BEDDING SLAB IN LIEU OF SUPPORT BLOCKS FOR PIPE WITHOUT PROJECTING BELLS. THE REQUIREMENTS FOR LOADING SHALL BE AS SPECIFIED FOR THE CONCRETE SUBBASE IN "PIPE IN JACKED CASING" NOTE 3.

▽ 5. CONCRETE BACKFILL

PRESSURE CONCRETE PLACING EQUIPMENT SHALL BE CAPABLE OF PLACING CONCRETE AT PRESSURES ADEQUATE TO PROPERLY BACKFILL THE TUNNEL AND ANY TUNNEL VOID SPACES ABOVE THE TUNNEL CROWN LAGGING. SUFFICIENT AIR SLUGGERS OR BOOSTERS SHALL BE USED TO INSURE PROPER PLACEMENT OF CONCRETE. TUNNEL BACKFILL SHALL BE 400-C (OR E)-2000 CONCRETE.

6. TRANSVERSE CONSTRUCTION JOINTS

TRANSVERSE CONSTRUCTION JOINTS, IF NEEDED BY THE CONTRACTOR'S OPERATIONS, SHALL BE PARALLEL WITH AND LOCATED AT THE ENDS OF BELLS. PLYWOOD, AT LEAST 1/2 INCH THICK, SHALL BE USED AS A FORM OR BULKHEAD AT THE JOINT LOCATION AND LEFT IN PLACE.