Effectiveness of Welded Wire Fabric as Shear Reinforcement in Pretensioned Prestressed Concrete T-Beams

by

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ABSTRACT

The use of welded wire fabric as shear reinforcement has become popular among precast concrete manufacturers because of its relative ease of placement and saving of time and money due to reduction of cutting, bending and labor. This thesis presents the test results conducted to evaluate the effectiveness of welded wire fabric as shear reinforcement as compared to commonly used conventional stirrups.

A total of six pretensioned prestressed single T-beams with identical flexural reinforcement and shear span-to-depth ratio were tested statically up to failure. The tested beams featured different shear reinforcement configurations including conventional single-legged, double-legged, and three different types of commercially available welded wire fabric (WWF). A beam without web reinforcement was also included in this study. All beams were designed with a nominal flexural strength higher than the shear strength.

All beams tested failed in diagonal shear with cracks at an inclination of less than 30 degrees to the horizontal. The concrete shear strength corresponding to the initiation of diagonal cracks was exactly the same as the code predictions. The ultimate shear strength of the tested beams was 53% to 83% higher than the code predictions.

Beams with deformed WWF were superior in comparison to the beams with conventional stirrups with respect to the number and the distribution of the diagonal cracks, and the stiffness of the beams. The beam with smooth WWF was the most superior in terms of the stiffness of the beam. The effectiveness of WWF was almost the same as that of conventional stirrups in terms of the maximum crack width, total crack width, and the shear strength of the beams. The presence of an additional horizontal wire at the mid-height of the beam had no significant influence on the crack pattern, maximum crack width, total crack width, and the stiffness of the beam. It did enhance the ductility of the WWF mesh as well as the ductility and ultimate shear strength of the beam.

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a	shear span
A	area of beam cross section
A_v	area of shear reinforcement
b_f	flange width of the beam
b_v	minimum effective web width within depth d_v
b_w	web width
C	total compression
d	effective depth
D	compressive force on the diagonal concrete strut
d_p	distance from extreme compression fiber to the centroid of prestressed reinforcement
d_s	distance from extreme compression fiber to the centroid of tension reinforcement
d'	distance from extreme compression fibre to the tip of stirrups in tension
d_v	effective shear depth, which can be taken as the distance between the resultants of the tensile and compressive forces due to flexure, but need not be taken less than 0.9 d.
e_1	maximum principal tensile strain of concrete based on the demec readings
e_2	minimum principal strain of concrete based on the demec readings
f_c	uniaxial compressive stress of concrete
f'_c	specified compressive strength of concrete
f_{ct}	tensile strength of concrete
f_d	stress due to unfactored dead load, at extreme fiber of section where tensile stress is caused by externally applied loads.

f_p	tensile stress in prestressed tendons
f_{pc}	compressive stress in the concrete, after all prestress losses have occurred, at the centroid of cross section
f_{pe}	compressive stress in concrete due to effective prestress forces only at extreme fibre of the section where tensile stress is caused by externally applied load.
f_{pu}	specified tensile strength of prestressing tendons
f_{py}	yield strength of prestressing tendons
f_{sp}	split tensile strength of concrete
f_{vo}	basic shear stress resistance provided by concrete
f_{vy}	yield strength of shear reinforcement
f_2	compressive stress in the diagonal strut
f_{2max}	diagonal crushing strength of concrete
F_L	force in the lower (tension) chord
F_u	force in the upper (compression) chord
F_{yL}	yield force in the lower (tension) chord
h	height of web
jd	distance between the resultants of the tensile and compressive forces due to flexure
ℓ	demec gauge length
M	applied moment
M_{cr}	cracking moment
M_d	moment due to unfactored dead load
M_f	factored moment at section
M_{max}	maximum factured moment at section due to externally applied loads
M_u	ultimate moment at section

M_{uo}	ultimate moment at section in the case of pure bending ($V_u = 0$)
N_f	factored axial force at section
N_p	axial force according to plane section theory
N_v	factored axial tensile force due to diagonal compression force
p_v	shear reinforcement ratio $(\frac{A_v\ f_{vy}}{f'_c\ b_w s})$
p_w	longitudinal reinforcement ratio $(A_s/b_w d)$
P_e	effective prestressed force, after all losses
s	spacing of stirrups
S	slide along the crack surface
T	total tension
u	vertical displacement
v	shear stress at section
V	applied shear
V_a	shear transferred by aggregate interlock along the diagonal tension crack
V_c	nominal shear strength provided by concrete
V_{ci}	nominal shear strength provided by concrete when diagonal cracking results from combined shear and moment.
V_{cw}	nominal shear strength provided by concrete when diagonal cracking results from excessive principal tensile stress in web
V_{cz}	shear carried by the compression zone
V_d	shear force at section due to unfactored dead load
V_D	shear transferred by dowel action by the longitudinal steel
V_f	factored shear force at section

V_i	factored shear force at section due to externally applied loads occurring simultaneously with M_{max}
V_n	nominal shear strength
V_p	vertical component of effective prestress force at section
V_s	nominal shear strength provided by shear reinforcement
V_{sy}	yield force in one stirrup
V_T	total shear capacity
V_u	factored shear force at section
V_{uo}	factored shear force at section in the case of pure shear (M_u = 0)
w	crack width
Z	distance between the tension and compression forces
α	angle between inclined stirrups and longitudinal axis of member
α^*	modified crack angle for calculating crack width
β	angle of assumed yield line with the horizontal
β_d	effective depth factor
β_n	axial compression factor
β_p	longitudinal reinforcement factor
ε_1	maximum principal strain
ε_2	minimum principal strain
ε_{co}	precompression strain of concrete due to prestressed force at that level
ε_{ct}	maximum tensile strain of concrete, 100 x 10^{-6}

ε_D	diagonal strain of concrete based on demec readings
ε_H	horizontal strain of concrete based on demec readings
ε_p	tensile strain in prestressed tendon
ε_{pu}	ultimate strain of prestressed tendons
ε_{py}	yield strain of prestressed tendons
ε_t	vertical strain
ε_V	vertical strain of concrete based on demec readings
ε_x	horizontal strain
ν	effectiveness factor of diagonal compression strength of concrete
γ_b	strength reduction factor
γ_c	strength reduction factor
ψ	degree of shear reinforcement
ϕ_c	resistance factor for concrete
ϕ_p	resistance factor for prestressed tendon
ϕ_s	resistance factor for reinforcement
τ	shear stress
θ	angle of inclination of diagonal compressive stresses with the horizontal
θ'	direction of the maximum principal tensile strain with the horizontal

CHAPTER 1

Introduction

1.1 General

In the design of concrete structures shear failure must be prevented. Due to its brittle nature, shear failure might take place suddenly and without warning. In order to increase the shear capacity of concrete members and to provide an adequate margin of safety, shear reinforcement is generally used in concrete structures. The use of welded wire fabric as shear reinforcement has become popular among precast concrete manufacturers because of its relative ease of placement and saving of time and money due to reduction of cutting, bending and labor. But there are very few studies available regarding the use of welded wire fabric as shear reinforcement.

1.2 Objectives

The objective of this research program was to evaluate the effectiveness of welded wire fabric as shear reinforcement in comparison to conventional stirrups for thin-webbed prestressed T-beams under static loading in terms of shear behavior and flexural behavior, which includes shear crack initiation, shear crack pattern, crack width, ultimate shear strength, flexural crack initiation, flexural crack pattern, and deflection. The effectiveness of different types of commercially available welded wire fabric was also compared and evaluated.

1.3 Scope

A total of six pretensioned prestressed single T-beams with identical flexural reinforcement and shear span-to-depth ratio were tested statically up to failure. The tested beams featured different types of shear reinforcement including conventional doublelegged, single-legged, and three different types of commercially available welded wire fabric (WWF). A beam without any web reinforcement was also included in this program in order to evaluate the contribution of concrete. All beams were designed with a nominal flexural strength higher than the shear strength to ensure failure model.

The background of welded wire fabric as well as results of previous studies regarding the use of WWF as shear reinforcement are presented in Chapter 2. This chapter also presents a brief review of shear in concrete beams and different analysis and design approaches. A detailed description of the experimental program, material properties, instrumentation, test set-up and testing procedure is given in Chapter 3. Chapter 4 summarizes all the test results including recorded and observed data during testing.

Chapter 5 includes the calculations of concrete strains, crack widths, and slides from the mechanical readings (demec readings). Then the test results are discussed and compared in detail in terms of flexural behavior and shear behavior.

Chapter 6 contains the conclusions based on this experimental program and the areas where further research should be conducted regarding welded wire fabric as shear reinforcement.

CHAPTER 2

Background and Literature Review

2.1 Introduction

Welded wire fabric (WWF) has been used in concrete walls, slabs, pipes and pavements for many years. It has been proven to be advantageous in controlling cracking and slowing the rate of deterioration after cracking. In recent years, WWF used as shear reinforcement has become popular among precast concrete manufacturers because of its relative ease of placement and saving of time and money due to reduction of cutting, bending and labor. The use of WWF as shear reinforcement also offers promise in prestressed precast concrete members with deep thin webs. This chapter reviews the general background and existing codes for WWF as shear reinforcement and the available published studies regarding the use of welded wire fabric as shear reinforcement in beams [8, 25, 45, 47, 49].

Because of the brittle nature of shear failure in the design of concrete structures an adequate margin of safety must be provided to prevent shear failure. This chapter reviews recent research results and design proposals concerning shear in prestressed concrete thin webbed beams [1, 4, 9, 12, 14, 16, 17, 21, 26, 27, 35].

2.2 Welded Wire Fabric (WWF)

Welded wire fabric (WWF) is manufactured from cold-drawn steel wires and generally tack-welded in an orthogonal mesh. The cold-drawing increases its strength but decreases its ductility [18, 32, 54]. Thus the strength of WWF is usually greater than that of conventional stirrups. The strength requirements given by ASTM and CSA Standards are shown in Table 2.1. The ultimate strain of WWF is usually less than 2.1%, while the ultimate strain of conventional stirrups is greater than 15%. The anchorage of WWF is provided by bond of vertical wires and dowel action of horizontal wires welded on the vertical wires. The conventional stirrups are hooked to both top and bottom longitudinal reinforcements. They provide not only good anchorage but also good confinement of concrete, and longitudinal bars can transfer some shear force by dowel action, while WWF could not. The weld of WWF is another weak point due to the stress concentration and weld strength.

There are very few studies [8, 25, 45, 47, 49] available regarding the use of WWF as shear reinforcement. Taylor and El-Hammasi [49] and Leonhardt and Walther [25] studied the shear behavior of reinforced concrete T-beams with u-shaped WWF as shear reinforcement. Leonhardt and Walther considered various anchorage arrangements in the compression zone. Taylor and El-Hammasi investigated the cracking behavior of beams and concluded that the u-shaped WWF shear reinforcement is more effective in crack control than the equivalent double-legged stirrups.

Obviously, the ease of placement of WWF would lead to savings in both fabrication and handling if the standardized plane sheets of WWF could be used as shear reinforcement. In 1980, the Joint

Prestressed Concrete Institute-Wire Reinforcement Institute (PCI/WRI) Ad Hoc Committee on Welded Wire Fabric for shear reinforcement [42] recommended the methods of anchorage for both smooth and deformed plane sheets of WWF used as shear reinforcement in thin-webbed concrete members. The recommendations are as follows:

1. For smooth WWF, two longitudinal wires with a minimum spacing of 2 inches (51 mm) with the inner wire not less than the greater of d/4 or 2 inches (51 mm) from the mid-depth of the member.
2. For deformed WWF, one longitudinal wire not more than d/4 from the extreme faces plus a development length above and below mid-depth in accordance with Section 12.8.2 of ACI 31817-77.

The cross-sectional area of one horizontal anchorage wire is recommended as 35% of the area of the vertical wires for smooth vertical wires and 40% of the area of the vertical wires for deformed vertical wires. These proposals are shown in Figure 2.1 and 2.2 respectively. On the basis of these recommendations, the 1983 ACI code provisions were revised to allow the use of plane sheets of WWF as shear reinforcement. However, this code still recommends using two horizontal anchorage wires at top and bottom for both smooth and deformed vertical wires, as shown in Figure 2.2

In 1982, Kevin Baskin of the University of Alberta [8] studied the shear behavior of reinforced concrete single T-beams with different types of plane sheet of WWF shear reinforcement. He tested eight beams with both smooth and deformed WWF and two with conventional single-legged stirrups in a 4 in. thick web. He concluded that the best anchorage was provided by two horizontal cross-wires at the top and bottom for smooth WWF. The anchorage by one smooth horizontal wire at top and bottom for deformed WWF also showed suitable performance. Up to service load, the maximum crack widths were essentially the same for both smooth and deformed WWF, but, at higher loads, the maximum crack widths were larger for smooth WWF than that for the deformed WWF. He also observed that the ductility of the beams increased with the increase of the amount of web reinforcement.

In 1985, Robertson and Durrani of Rice University [47] tested nine bonded and unbonded prestressed concrete single T-beams with plane sheets of WWF as shear reinforcement and one with conventional single-legged stirrups made of #2(6.35 mm) smooth bars and three without shear reinforcement. They concluded that the anchorage with two horizontal wires should be used to protect against localized weakness in the mesh. They mentioned that the beams with less web reinforcement than the minimum required by ACI and CSA codes carried much higher loads than predicted.

In 1986, A. Ray and S. Rizkalla of the University of Manitoba [45] studied the behavior of thin-webbed prestressed concrete beams with different shear reinforcement configurations. They tested seven beams with different types of shear reinforcements including conventional single-legged, double-legged stirrups, and four different types of welded wire fabric and two beams without web reinforcement. They concluded that the behavior of prestressed concrete beams with WWF meshes was essentially the same as that of beams with conventional shear reinforcement under the service load. No conclusion was drawn at ultimate load because of the premature failure of the tested specimen due to slippage of the prestressed strands.

2.3 General Background of Shear Behavior

In spite of considerable research on, and analysis of, the behavior of reinforced and prestressed concrete in shear, no general theory has been established for all types of concrete structures. Extensive experimental work has greatly extended the identification of various shear resisting mechanisms.

The joint ASCE-ACI Committee 426 [3] on Shear and Diagonal Tension (ASCE-ACI, 1973) prepared a very useful review of the shear problem and the background of the current ACI Code provisions [1, 2].

2.3.1 Basic mechanisms of shear transfer

The main types of shear transfer are the following: (a) shear stress in the uncracked concrete; (b) interface shear transfer; (c) dowel action; (d) arch action; and (e) shear reinforcement. The forces acting at an inclined crack of a beam are shown in Figure 2.3 where

V_{cz} = shear carried by the compression zone

V_a = shear transferred by aggregate interlock along the diagonal tension crack

V_D = shear transferred by dowel action by the longitudinal steel

V_s = shear transferred by the stirrups.

Thus, the total shear capacity, V_T, is:

$$V_T = V_{cz} + V_a + V_D + V_s \tag{2.1}$$

The principal mechanisms of shear resistance could be categorized as: A) arch action; B) beam action; and C) truss action, as shown in Figure 2.4.

2.3.2 Types of inclined shear cracking

Shear failures of beams are characterized by the occurrence of inclined cracks. Inclined cracks in the web of a beam may develop either before a flexural crack occurs in their vicinity or as an extension of a previously developed flexural crack. The first type of inclined crack is often referred to as a "web-shear crack" [Figure 2.5(a)]; the second type is often identified as a "flexure-shear crack" [Figure 2.5(b)].

In addition to the primary cracks (flexural and the two types of inclined cracks), secondary cracks often result from splitting forces developed by the deformed bars, or from dowel action forces.

2.3.3 Factors affecting shear strength

There are numerous factors which affect the shear strength and serviceability of beams [3, 6, 11, 20, 22, 38, 43, 48, 54, 55]. The main parameters which affect the shear behavior of a prestressed concrete beam are:

a. the shear span-to-depth ratio

b. the compressive strength of the concrete

c. the percentage and type of web reinforcement

d. the percentage of longitudinal reinforcement

e. the size and shape of cross sections

f. the type of loading

g. the magnitude of effective prestressing force.

The shear span-to-depth ratio a/d or M/Vd is a very important variable in defining the shear strength of a beam [3, 11] (see Figure 2.6). The shear carried by the compression zone and interface along the diagonal tension crack is mainly dependent on the compressive strength of the concrete [6]. The shear transferred by the dowel action is directly affected by the percentage of longitudinal reinforcement.

2.4 Traditional Truss Model and ACI Design Procedure

When a web-reinforced concrete member is subjected to flexure moment and shear force cracks, form when the principal tensile stresses exceed the tensile strength of the concrete. In a region of high shear force, significant principal tensile stresses may be generated at an angle of approximately 45° to the axis of the member as shown in Figure 2.7.

The ACI Building Code [1, 2] assumes the resistance of a beam member V_n is made up of two parts; i.e., concrete contribution, V_c, and tranverse reinforcement contribution, V_s:

$$V_n = V_c + V_s \quad (2.2)$$

The shear carried by the concrete V_c is taken equal to the inclined cracking shear for web reinforced beams, and would be the failure load for a beam without web reinforcement. The ACI Code takes into account the major factors influencing shear resistance, such as the tensile strength of the concrete as measured by the ultimate compressive strength, f'_c, and the shear span-to-depth ratio, $\frac{M_u}{V_u d}$ which is related to arch action. When the effective prestress force is equal to or greater than 40% of the tensile strength of the prestressed reinforcement, the shear carried by the concrete, V_c, could be evaluated as follows:

$$V_c = \left(\frac{f'_c}{20} + 5\,\frac{V_u d_p}{M_u}\right) b_w d \qquad \text{(kN)} \quad (2.3)$$

$$V_c \geq \frac{\sqrt{f'_c}}{6}\, b_w d \quad (2.4)$$

$$V_c \leq 0.4\,\sqrt{f'_c}\;\; b_w d \quad (2.5)$$

and

$$\frac{V_u d_p}{M_u} < 1 \quad (2.6)$$

where V_c = nominal shear strength provided by concrete, kN

f_c' = ultimate compressive strength of concrete, MPa

V_u = factored shear force at section, kN

M_u = factored moment at section, kN.m

d_p = distance from extreme compression fiber to centroid of prestressed reinforcement, mm

d = distance from extreme compression fiber to centroid of longitudinal tension reinforcement, but need not be less than 0.8h, mm

b_w = web width, mm.

Shear strength at inclined "flexure-shear crack" or shear strength provided by concrete, V_{ci}, when diagonal cracking results from combined shear and moment, is

$$V_{ci} = \left(\frac{\sqrt{f_c'}}{20}\right) b_w d + V_d + \frac{V_i M_{cr}}{M_{max}} \tag{2.7}$$

$$V_{ci} < \left(\frac{f_c'}{7}\right) \quad b_w d \tag{2.8}$$

where

$$M_{cr} = \frac{I}{y_b} \left[\left(\frac{\sqrt{f_c'}}{2}\right) + f_{pe} - f_d\right] \tag{2.9}$$

$$V_i = V_u - V_d \tag{2.10}$$

$$M_{max} = M_u - M_d \tag{2.11}$$

V_d, f_d and M_d refer to the shear force, the extreme fiber flexural stress, and moment due to the unfactored dead load resulting from self-weight of the member only. And V_i and M_{max} are the factored shear force and maximum factored moment at a section due to externally applied loads.

When the shear causes a principal tensile stress of approximately $\frac{\sqrt{f'_c}}{3}$ at the centroidal axis of the cross-section, web-shear cracking, V_{cw} , occurs. V_{cw} is predicted by the following equation:

$$V_{cw} = 0.3\ (\sqrt{f'_c} + f_{pc})\ b_w d + V_p \qquad (2.12)$$

The shear carried by the web reinforcement, V_s, is based on the truss analogy developed by Litter [46] and Morsch [33] which assumes that, after cracking, the concrete can carry no tension, and the cracked web-reinforced concrete beam acts as a truss with parallel longitudinal chords (compression zone and tensile steel) and with a web composed of diagonal concrete struts and transverse steel ties (see Figures 2.4 and 2.8). Thus,

$$V_s = A_v f_{vy}\ (jd)\ (\text{Sin}\alpha\ \cot\theta + \cos\alpha)/s \qquad (2.13)$$

where A_v = area of shear reinforcement within a distance s, mm^2

f_{vy}= yield strength of shear reinforcement, MPa

jd = moment arm of cross-section, mm

α = angle between inclined stirrups and longitudinal axis of member, degrees

θ = angle of inclination of diagonal compressive stresses to the longitudinal axis of the member, degrees.

ACI assumes the angle of the compressive stress θ as 45°. Usually α is 90° and takes $jd \simeq d$, then:

$$V_s = \frac{A_v f_{vy} d}{S} \tag{2.14}$$

$$\text{However } V_s \not> \frac{2}{3}\sqrt{f'_c}\, b_w d \;. \tag{2.15}$$

2.5 Canadian Standards Association

The method used in the National Building Code of Canada was semi-experimental and was exactly the same as the relations in ACI Code (ACI 318) until the 1977 Code. The chapter for shear and torsion of the new Code (CAN3-A23.3-M84) [14] presents two alternative design procedures, i.e., the Simplified Method and the General Method

2.5.1 Simplified Method

The Simplified Method is almost the same as that in the ACI Code except load factors are different. It uses 1.25 for dead load factor, and 1.50 for live load, wind load, and earthquake load factor. The Code introduces new material resistance factors (ϕ's) to provide an adequate margin of safety.

For members with an effective prestress force of not less than 40% of the tensile strength of the flexural reinforcement:

$$V_c = (0.06 \sqrt{f_c'} + 6 \frac{V_f}{M_f} d_p) \phi_c b_w d \text{ (kN)} \quad (2.16)$$

$$V_c \nless 0.2 \phi_c \sqrt{f_c'} b_w d \quad (2.17)$$

$$V_c = \ngtr V_{cw} \quad (2.18)$$

where $$\frac{V_f}{M_f} d_p \ngtr 1.0 \quad (2.19)$$

ϕ_c is material factor for concrete and is equal to 0.6

$$V_{cw} = 0.4 \phi_c \sqrt{f_c'} \left(\sqrt{1 + \frac{f_{pc}}{0.4 \phi_c \sqrt{f_c'}}} \right) b_w d_p + \phi_p V_p \quad (2.20)$$

where

$d_p \nless 0.8h$

ϕ_p is material factor for prestress strand and is equal to 0.9.

$$V_s = \frac{\phi_s A_v f_{vy} d}{s} \quad (2.21)$$

where ϕ_s is the material factor for stirrups and is equal to 0.85.

2.5.2 General Method

The General Method is based on the "compression field theory" which is derived from Wagner's "tension field theory" [54]. In 1929, Wagner studied the postbuckling shear resistance of thin-webbed metal girders. He assumed that after buckling the thin webs would not resist compression and that the shear would be carried by a field of diagonal tension. M.P. Collins and F. Vechio of the University of Toronto [52], and D. Mitchell of McGill University [16] used a similar concept to reinforced and prestressed concrete beams.

The basic idea is that the resistance and behavior of members in shear can be investigated in detail by performing a sectional analysis that considers the equilibrium, compatibility and stress-strain requirements for different portions of the section. Such an analysis (see Figure 2.9) would show that the direction of principal compressive stresses changes over the depth of the beam. A more direct procedure, which concentrates on the conditions at mid-depth of the beam is used with the following assumptions (see Figure 2.10):

1. The shear stresses are uniformly distributed over an area b_v wide and d_v deep.
2. The inclination of the principal compressive stress, θ, coincides with the inclination of the principal compressive strains.
3. The direction of the principal compressive stresses remains constant over the depth, d_v.
4. Concrete resists no tension after cracking.
5. If the web concrete is severely deformed (large ε_1) its ability to resist compressive stress, f_2, will be substantially reduced (52). Thus the maximum value of f_2 should not exceed the diagonal crushing strength of the concrete, f_{2max}:

$$f_{2max} = \phi_c f_c'/(0.8 + 170\ \varepsilon_1) \qquad (2.21)$$

and $$f_{2max} \leq \phi_c f_c' \qquad (2.22)$$

where ε_1 = principal tensile strain in cracked concrete due to factored loads.

Figure 2.11 shows the stress and strain conditions (Mohr's circle) at mid-depth after cracking. From the stress and strain circles the following expressions can be derived.

$$f_2 = (\tan\theta + 1/\tan\theta)\ V_f/b_v d_v \tag{2.23}$$

$$\varepsilon_1 = \varepsilon_x + (\varepsilon_x + 0.002)/\tan^2\theta \tag{2.24}$$

In evaluating sectional resistance, θ may be chosen to have any value between 15° and 75° (see Figure 2.12). However, the same value of θ must be used in satisfying all the requirements at a section. The transverse reinforcement must yield prior to crushing of the concrete. This condition limits the maximum shear that a given cross-section can resist, as shown by the dashed lines in Figure 2.12. The longitudinal reinforcement shall be designed by the plane sections theory to resist the factored moment, M_f, and the axial load, N_f, together with the additional factored axial tensile load, N_v, acting at mid-depth of the member.

$$N_v = \frac{V_f}{\tan\theta} \quad . \tag{2.25}$$

For designing in shear according to the General Method, the following steps should be followed:

Step 1: Calculate the magnitude of ε_x at mid-depth for factored external loads by plane section analysis.

Step 2: Select a value of θ, (see Figure 2.12).

Step 3: Calculate $f_2 = (\tan\theta + 1/\tan\theta)\ V_f/(b_v d_v)$

Step 4: Calculate $\varepsilon_1 = \varepsilon_x + (\varepsilon_x + 0.002)/\tan^2\theta$.

Step 5: Calculate $f_{2max} = \phi_c f_c'/(0.8 + 170\ \varepsilon_1)$

Step 6: Check whether $f_2 < f_{2max}$, if not, return to "Step 2".

Step 7: design transverse reinforcement by

$$V_r = \frac{\phi_s\ A_v\ f_{vy}\ d_v}{s\ \tan\theta} + \phi_p\ V_p \geqq V_f\ . \qquad (2.26)$$

To obtain the ultimate shear capacity of a given section requires extensive computations. It is suggested to write a computer program with the following steps.

Step 1: Choose a value of ε_1.

Step 2: Estimate θ.

Step 3: Estimate stirrup stress, f_v.

Step 4: Calculate $V = \phi_s\ A_v\ f_v\ d_v/(s\ \tan\theta)$.

Step 5: Calculate $f_2 = (\tan\theta + 1/\tan\theta)\ V/(b_v d_v)$.

Step 6: Calculate $f_{2max} = \phi_c f_c'/(0.8 + 170\ \varepsilon_1)$

Step 7: If $f_2 > f_{2max}$, return to "Step 2" or "Step 1" and choose θ closer to 45° or lower ε_1, respectively.

Step 8: Calculate $\varepsilon_2 = -0.002\ (1 - \sqrt{1 - f_2/f_{2max}})$.

Step 9: Calculate $\varepsilon_t = (\varepsilon_1 + \varepsilon_2 \tan^2\theta)(1 + \tan^2\theta)$.

Step 10: Calculate $f_v = \phi_s\ E_s\ \varepsilon_t$ but $f_v \leqq \phi_s\ f_y$.

Step 11: If necessary, return to "Step 3" with better estimate of f_v.

Step 12: Calculate $\varepsilon_x = \varepsilon_1 + \varepsilon_2 - \varepsilon_t$.

Step 13: Calculate top strain with this ε_x at mid-depth of the beam, and calculate the corresponding moment, M_f, and axial force, N_p.

Step 14: Calculate net axial load acting on the section, $N_f = N_p - V/\tan\theta$

Step 15: If N_f does not equal desired value, return to "Step 2" and change θ (increasing θ increases N_f).

Step 16: To obtain complete response, return to "Step 1" and choose another value of ε_1.

Step 17: Plot ε_1 - V diagram.

2.6 Variable Angle Space Truss Model

In the late 1960's, researchers in Europe were working with the idea of a conceptual model to properly represent the behavior of concrete members subjected to torsion and shear. The main objectives were to rationalize and, at the same time, simplify the design procedures in these areas.

Based on the studies of Thürlimann [51] and the compression field theory [16, 52], J.A. Ramirez and J.E. Breen of the University of Texas at Austin [44] modified the traditional truss model with variable angle of inclination of the diagonal compression stress as a design model.

A typical crack pattern of a beam with two symmetrical loads is shown in Figure 2.13. The corresponding truss model is shown in Figure 2.14. The space-truss model uses a variable angle of inclination of the concrete struts, θ, instead of Ritter's constant 45° angle. This angle of inclination is at ultimate load and not at first inclined cracking. The angle is such that in the field where failure occurs when both the longitudinal and transverse reinforcements reach their yield stresses.

Considering the cracked web of a beam (Figure 2.15) and the yielding of bottom reinforcement and stirrups:

$$f_c = \frac{V_u}{b_w Z \sin\theta \cos\theta} \tag{2.27}$$

$$F_{yL} = \frac{M_u}{Z} + \frac{V_u}{2} \cot\theta \tag{2.28}$$

$$V_{sy} = A_v f_{vy} = \frac{V_u s \tan\theta}{Z} \tag{2.29}$$

$$\tan\theta = \frac{V_{sy} Z}{V_u s} \tag{2.30}$$

From (2.28) to (2.30)

$$F_{yL} = \frac{M_u}{Z} + \frac{V_u^2 s}{2V_{sy}Z} . \tag{2.31}$$

In the case of pure bending ($V_u = o$)

$$M_{uo} = F_{yL}Z \quad . \tag{2.32}$$

In the case of pure shear ($M_u = o$)

$$V_{uo} = (2F_{yL} V_{sy}\bar{z}/s)^{0.5} \tag{2.33}$$

Thus the interaction equation between bending and shear for $F_L = F_{yL}$ and $V_s = V_{sy}$ is

$$\frac{M_u}{M_{uo}} + \left(\frac{V_u}{V_{uo}}\right)^2 = 1 . \tag{2.34}$$

The interaction diagram is shown in Figure 2.16. Three types of failure mechanisms can be expressed from this diagram. The bending mechanism represents the yielding of the longitudinal reinforcement without yielding of transverse reinforcement. Similarly, the shear mechanism represents the yielding of the transverse reinforcement without yielding of longitudinal reinforcement. And the combined mechanism represents the yielding of both the longitudinal and transverse reinforcements.

2.7 The Theory of Plasticity

The formulation of a complete theory of perfectly plastic material was first given by Gvozdev. Within the last decade, M.P. Nielsen, et al., [10, 35, 36] at the Technical University of Denmark applied this theory to reinforced and prestressed concrete members. Similar research has been carried out at various other institutions, notably at the Swiss Federal Institute of Technology in Zurich by Lampest [26], Thürlimann [19, 50, 51], Grob [19], and Muller [36].

Application of plasticity theory to shear in beams gives ultimate load of collapse and the angle of major failure shear crack in the shear span. To apply the plasticity theory to shear in beams, the reinforced concrete is assumed as a rigid plastic material and the lower bound theorem and upper bound theorem are used to determine the load-carrying capacity of concrete beams.

2.7.1 Lower bound theorem

The definition of the lower bound theorem can be stated as follows: "If the load has such a magnitude that it is possible to find a stress distribution corresponding to stresses within yield surface and satisfying the equilibrium conditions and the static boundary conditions for the actual load, then this load will not be able to cause collapse of the body".

In a simply supported beam loaded by two symmetrical forces, as shown in Figure 2.17, the beam web is assumed to be a homogeneous stress field as shown in Figure 2.18. The following equilibrium equations can be written.

$$f_2 = v\ (\tan\theta + \cot\theta) \tag{2.35}$$

$$V_s = A_v\ f_v d/(s\ \tan\theta) \tag{2.36}$$

where v = external applied shear stress at section

When the compression stringers are strong enough, the best lower bound solution is the largest load satisfying $f_c \leqq f_c'$ and $f_s \leqq f_{vy}$. Introducing ψ as the degree of shear reinforcement:

$$\psi = \frac{A_v\ f_{vy}}{b_w\ s\ f_c'} \quad . \tag{2.37}$$

Thus, from equation (2.35) and (2.36)

$$\frac{v}{f_c'} = \sqrt{\psi(1 - \psi)} \tag{2.38}$$

$$\tan\theta = \sqrt{\psi/(1 - \psi)}. \tag{2.39}$$

The maximum value of v/f_c' is 0.5 which can be obtained for $\psi = 0.5$. The best lower bound solution is:

$$\frac{v}{f_c'} = \sqrt{\psi(1 - \psi)} \qquad \psi \leqq 0.5 \tag{2.40}$$

$$\frac{v}{f_c'} = 0.5 \qquad \psi > 0.5 \quad . \tag{2.41}$$

2.7.2 Upper bound theorem

The definition of the upper bound solution is as follows: "If various geometrically possible strain fields are considered, the work equation can be used to find values of the load-carrying capacity that are greater than or equal to the true one".

Consider again a beam with two symmetrical forces, the shear failure mechanism is shown in Figure 2.17. The work equation is assumed to take the following form:

$$p \cdot u = \frac{A_v\ f_{vy}\ d}{s} \cot\beta\ u + \frac{1}{2} f_c'\ b\ (1 - \cos\beta) \frac{d}{\sin\beta} u \tag{2.42}$$

The first term on the right is the dissipation in the stirrups crossing the yield line; the second term is the dissipation in the concrete.

Using the degree of shear reinforcement, ψ, and minimizing v/f_c' with respect to β, the upper bound solution is

$$\frac{v}{f_c'} = \sqrt{\psi\ (1 - \psi)} \tag{2.43}$$

$$\tan\beta = 2\sqrt{\psi(1 - \psi)}/(1 - 2\psi) \tag{2.44}$$

$$\beta = 2\theta \quad . \tag{2.45}$$

For $\psi = 0.5$, $\beta = \pi/2$ corresponds to a vertical yield line, for $\psi > 0.5$, there is no increase in load-carrying capacity. Thus, the upper bound solution is

$$\frac{v}{f_c'} = \sqrt{\psi(1 - \psi)} \qquad \psi \leqq 0.5 \tag{2.46}$$

$$\frac{v}{f_c'} = 0.5 \qquad \psi > 0.5 \tag{2.47}$$

which is identical to the lower bound solution. Thus, this solution is the "exact solution".

For design of shear reinforcement in beams, the amount of transverse shear reinforcement is:

$$A_v = \frac{V \cdot s \cdot \tan\theta}{d\ f_{vy}} \quad . \tag{2.48}$$

The concrete stress, f_c, has to satisfy the condition of $f_c \leqq \nu f_c'$ where ν is an effectiveness factor for the effective plastic compressive strength of the concrete. Based on an extensive experimental test program [7, 10], ν is taken as:

$$\nu = 0.7 - f_c'/200 \quad . \tag{2.49}$$

2.8 Predictions by Different Design Codes and Researchers

Based on extensive experimental studies of concrete beams, there are many existing design equations for predicting the shear strength of the concrete beam. In this section several design codes and proposed equations considered to be the most suitable to this research program will be reviewed.

2.8.1 Recommendations by the Japanese Society of Civil Engineers (JSCE)

(1) The JSCE Committee [23] recommended the following relations for design of shear strength of both reinforced and prestressed concrete beams:

$$V_n = V_c + V_s \tag{2.50}$$

$$V_c = 0.94\,(f_c')^{1/3}(1 + \beta_d + \beta_p + \beta_n)\,\frac{b_w d}{\gamma_b \gamma_c} \tag{2.51}$$

$$V_s = A_v\, f_{vy}\, \frac{z}{s}\,(\text{Sin}\alpha + \cos\alpha)/\gamma_b \tag{2.52}$$

where

$$\beta_d = \left(\frac{1000}{d}\right)^{1/4} - 1 \qquad \geqq 0 \tag{2.53}$$

$$\beta_p = \sqrt{100.p_w} \quad - 1 \qquad \leqq 0.73 \tag{2.54}$$

$$\beta_n = M_o/M_d \;\leqq 1.0 \tag{2.55}$$

p_w is the longitudinal reinforcement ratio $p_w = \frac{A_s}{b_w d}$

γ_b and γ_c are strength reduction factors, $\gamma_b = 1.15$, and $\gamma_c = 1.30$

Z is the distance between the tension and compression forces and $Z = d/1.15$.

The unit of f'_c is kg/cm^2.

(2) Okamura-Higai's Equation

H. Okamura and T. Higai [39] in Japan proposed the following design equation:

$$V_c = 0.94\ (f'_c)^{1/3}(0.75 + 1.40\ \frac{d}{a})(1 + \beta_d + \beta_p + \beta_n)\ b_w d \qquad (2.56)$$

(3) Niwa's Equation

In 1983, J. Niwa of the University of Tokyo [38] studied the shear resistant mechanism of reinforced concrete members and presented the following equation. (a/d < 3)

$$V_c = 0.53\ (f'_c)^{2/3}(1 + \frac{333}{d})[1 + \sqrt{100\ p_w})b_w d\ /(1 + (\frac{a}{d})^2] \qquad (2.57)$$

2.8.2 CEB/FIP Code

The CEB/FIP Model Code for concrete structures of 1978 [15] presented the design equations as follows:

$$V_c = f_{vo}\ \beta_d\ \beta_p\ \beta_n\ \beta_a\ b_w d \qquad (2.58)$$

where $f_{vo} = 0.26 + 0.008(f'_c - 20)(MPa)$

$$\text{for } 20 \leqq f'_c \leqq 50 \text{ (MPa)} \tag{2.59}$$

$$\beta_d = 1.6 - \frac{d}{1000} \geqq 1.0 \tag{2.60}$$

$$\beta_p = 1 + 50\ p_w \qquad p_w = \frac{A_s}{b_w d} \leqq 0.02 \tag{2.61}$$

$$\beta_n = 1 + \frac{M_o}{M_d} \leqq 2 \tag{2.62}$$

$$\beta_a = \frac{2d}{a} \geqq 1 \tag{2.63}$$

2.8.3 Predictions by different researchers in the United States

1. T. Zsutty's equation [56]

$$V_c = 2.1372\ (f'_c\, p_w \frac{d}{a})^{1/3}\ b_w d \tag{2.64}$$

2. A. Placas and P.E. Regen [41]

$$V_c = 0.2898\ (f'_c\ \frac{100\ A_s}{b_w d})^{1/3}\ b_w d \tag{2.65}$$

and

$$V_u = 2(d' - t)\frac{A_v}{s}\ f_{vy} + 0.9056\ (f'_c)^{1/3}\ (b_w + 152.4)t \tag{2.66}$$

where t is the thickness of the compression flange

d' is the distance from compression fibre to the tip of stirrups in tension.

3. K.S. Rajagopalan and P.N. Ferguson [43].

$$V_c = 0.083\ (0.8 + 100\ p_w)\sqrt{f'_c}\ b_w d \leqq 0.166\ \sqrt{f'_c}\ b_w d \tag{2.67}$$

4. M.J. Haddadin, S. Hong, and A. H. Matlock [20]

$$V_c = (0.1577 \sqrt{f'_c} + 17.23 \, p_w \frac{Vd}{M}) \, b_w d \leqq 0.29 \sqrt{f'_c} \, b_w d \qquad (2.68)$$

$$V_s = 1.75 \, A_v \, f_{vy} \frac{d}{s.\sin\alpha} \quad \text{for} \; \frac{A_v \, f_{vy}}{b_w.s.\sin\alpha} \leqq 0.112 \, f'_c \sqrt{\frac{d}{a}} \qquad (2.69)$$

or

$$V_s = (0.5 \frac{A_v \, f_{vy}}{b_w.s.\sin\alpha} + 0.14 \, f'_c \sqrt{\frac{d}{a}})$$

$$\text{for} \; \frac{A_v \, f_{vy}}{b_w.s.\sin\alpha} > 0.112 \, f'_c \sqrt{\frac{d}{a}} \qquad (2.70)$$

CHAPTER 3

Experimental Program

3.1 Introduction

The advantages of welded wire fabric (WWF) as shear reinforcement are speed of fabrication of reinforcement and the relative ease of handling and lower overall cost. But it was believed that as far as the structural behaviors were concerned, WWF was less effective than conventional stirrups. The experimental program in this thesis is designed to study the effectiveness of WWF as shear reinforcement in terms of the following:

1. Shear behavior as compared to conventional stirrups in terms of shear crack initiation, shear crack pattern, crack width, and ultimate strength.
2. Flexural behavior as compared to conventional stirrups in terms of flexural crack initiation, flexural crack pattern and deflection.
3. Type and configuration of WWF comparing the different types of commercially available WWF.

A total of six pretensioned prestressed T-beams with identical flexural reinforcement and shear span-to-depth ratio are designed in this program. In order to compare the behavior , five different shear reinforcement configurations including conventional double-legged, single-legged, and three different types of commercially available WWF were used. The shear contributions of these shear reinforcements in terms of $\frac{A_v f_{vy}}{f'_c b_w s}$

are almost the same. One beam without any web reinforcement was also included in order to investigate the shear contribution of concrete.

3.2 Test Specimen

The beam dimensions are mainly controlled by the steel casting bed of a double T-beam donated by a local prefabricated plant, Genstar Structures Ltd., which is used for commercial beams. The design was conducted according to the ACI Code [1] and CSA Code [14].

All the specimens tested had the same dimensions, as shown in Figure 3.1. The cross-section of the beams was 650 mm flange width, 490 mm overall depth, 60 mm flange thickness, and a tapered web with 85 mm bottom to 140 mm top width. The beam length was 4500 mm. In order to make the beams critical in shear, the total span was chosen as 3000 mm and the shear span-to-depth ratio a/d was 2.91.

A total of six pretensioned prestressed concrete single T-beams were tested in this experimental program. The only parameter varied among these six beams was the type and configuration of the shear reinforcement. In order to identify the specimens, the notations were designed to reflect the following parameters: (a) type of beam (prestressed or reinforced); (b) type of loading (static or cyclic); (c) consecutive number in this phase, and (d) the type of shear reinforcement. A typical notation is shown as follows:

PSN4-WDH

- deformed WWF with an additional horizontal wire at mid-height of the beam
- consecutive number
- new dimensions (to distinguish from the beams tested by A. Ray)
- under static loading
- prestressed

The tested six beams and the types and configuration of the shear reinforcement provided were:

(a) PSN1-0 without shear reinforcement

(b) PSN2-WD with deformed WWF

(c) PSN3-D2 with conventional double-legged stirrups

(d) PSN4-WDH with deformed WWF with an additional horizontal wire at mid-height of the beam

(e) PSN5-S6M with conventional single-legged stirrups

(f) PSN6-WS with smooth WWF

The different types of stirrup configurations are shown in Figure 3.2.

3.3 Longitudinal Reinforcements

To ensure that shearing distress would occur before flexure failure, the longitudinal reinforcements were designed to have a nominal flexural capacity 85% greater than their predicted shearing capacity with the heaviest shear reinforcement. The main longitudinal tension reinforcements were three 20M-400 MPa and two 15M-400 MPa deformed bars, and two 13 mm 7-wire stress-relieved prestressed strands with a specified minimum tensile strength of 1860 MPa. Typical longitudinal tension reinforcements are shown in Figure 3.3. Two #3 (9.5 mm) -400 MPa deformed bars were used as longitudinal compression reinforcements. The total percentage of longitudinal reinforcement was 3.0%. The bottom 20M tension rebar was anchored with the end plates welded on it. The other four longitudinal tension rebars were anchored using standard 90° bends at the ends. The two tendons were anchored at the ends of the beam by means of the anchor device as shown in Figure 3.4. Because of high tensile splitting stress that existed at the ends, 50 mm spirals were used in addition to the double-legged stirrups as shown in Figure 3.4.

A 4x4-W4XW4 (0.225 inch diameter) welded wire mesh was provided in the flange at 10 mm clear cover at sides and top. The cross-section of the beam PSN1-0 without shear reinforcement is shown in Figure 3.5.

3.4 Shear Reinforcements

3.4.1 Conventional stirrups

Two types of conventional stirrups were used, i.e., single-legged and double-legged stirrups.

The single-legged stirrups were made of 6 mm deformed bars. The anchorages at top and bottom were provided by standard 90° and 180° hooks respectively. At the top of the beam, the hook was placed around the #3 longitudinal compression rebars and at the bottom, they surrounded the bottom 20M bar. The beam with single-legged stirrups, PSN5-S6M, is shown in Figure 3.6. The concrete covers, at the top and bottom of the stirrups were 24 mm and 14 mm, respectively. The stirrups were placed at 150 mm centre to centre and they were offset by 13 mm from the centreline of the web.

The u-shaped double-legged stirrups were made of #2 (6.25 mm) smooth bars. The anchorage at the top was provided by standard hooks. All the longitudinal tension rebars were enclosed by the double-legged stirrups, and the two #3 compression rebars were tied at the top inner curvatures of the stirrups. The beam with double-legged stirrups, PSN3-D2, is shown in Figure 3.7. The concrete covers, at top and bottom of the stirrups were 30 mm and 14 mm, respectively.

3.4.2 Welded wire fabric (WWF)

A total of three different types of plane sheet WWF was chosen with the anchorage arrangements satisfying both the PCI/WRI

Ad Hoc committee recommendations [41] and the ACI Code [1].

The WWF used in beam PSN2-WD consisted of D4.7 (6.20 mm) deformed vertical wires with two W2.5 (4.52 mm) horizontal wires spaced at 51 mm centre to centre welded at the top and bottom. The WWF used in beam PSN4-WDH consisted of the same wires as beam PSN2-WD, with an additional horizontal wire of W2.5 welded at mid-height of the beam. The WWF in beam PSN6-WS consisted of W4.7 (6.20 mm) smooth vertical wires with two W2.5 horizontal wires welded at the top and bottom. Since there were only smooth WWF meshes with an additional horizontal wire at mid-height available in the structural laboratory, this WWF was obtained by cutting the mid-height wire. The clear concrete covers, at top and bottom were 20 mm and 10 mm, respectively. And the meshes were offset from the web centreline by 13 mm. The layouts and cross-sections of these beams are shown in Figures 3.8 to 3.10.

3.5 Material Properties

3.5.1 Concrete

The nominal design strength of concrete was 35 MPa at 28 days after casting. The design slump of concrete was about 100 mm. Concrete was supplied by a local concrete mix company. Ready-mixed concrete with normal portland cement and 15 mm maximum aggregate size was used. The following compositions were used in each mix for one cubic meter of concrete:

Normal portland cement:	325 kg
Sand:	925 kg
15 mm aggregate:	1000 kg
Water:	170 kg
Water reducer:	1120 mc
(Master Builder #322 N)	

The total quantity required for each cast was 1.0 cubic metre. The idealized stress-strain curve of the concrete in uniaxial compression is shown in Figure 3.11 [34, 37].

3.5.2 <u>Prestressed strands</u>

The nominal tensile strength of the 1/2-inch (13 mm) 7-wire stress-relieved prestressed strands was 1860 MPa. Three samples were tested by attaching an electrical extensometer with 50.8 mm gauge length. The average ultimate tensile strength obtained was 1823 MPa with an ultimate elongation of 6.5%. Figure 3.12 shows a typical stress-elongation curve for a prestressed strand.

3.5.3 <u>Longitudinal reinforcements</u>

The longitudinal tension reinforcements were two 15M (16 mm) -400 MPa, and three 20M (20 mm) -400 MPa deformed bars. The longitudinal compression reinforcements were two #3 (9.5 mm) bars, and the slab reinforcement was 4x4-W4xW4 welded wire mesh. The tensile tests were performed for two samples of each type by attaching electrical extensometer. The typical stress-strain relationships are shown in Figures 3.13 to 3.15. The properties of prestressed and longitudinal reinforcements are tabulated in Table 3.1.

3.5.4 Shear reinforcements

3.5.4.1 Conventional Stirrups. Two types of conventional stirrups were used. For single-legged stirrups 6 mm nominal diameter deformed bars were used; for double-legged stirrups #2 (6.35 mm) smooth bars were used. Tension tests were performed in a similar way for five samples in each case. The typical stress-strain diagrams for both cases are shown in Figures 3.16 and 3.17, respectively. The yield strengths for 6 mm deformed bars were determined corresponding to 0.35% elongation on the stress-strain diagram, as indicated in Section 3.5.3.2 of the ACI Code [1].

3.5.4.2 Welded Wire Fabric (WWF). All the types of welded wire fabric were tested in a similar way. For the wire fabrics with the additional horizontal wire at mid-height, the extensometer was attached around the cross-weld. It was observed that all the samples of deformed wire fabric without welds broke suddenly without any plastic deformation. The yield load for those cases was considered as the maximum load carried by the sample, and the stress-strain diagram is shown in Figure 3.18. For other wire samples, the yield strengths were considered by taking the average values of stresses corresponding to 0.35% of elongation according to Section 3.5.3.2 of ACI Code [1]. The typical stress-strain diagrams for these cases are shown in Figures 3.19 and 3.20. The properties of shear reinforcements are shown in Table 3.2.

3.6 Construction of The Specimens

3.6.1 Preparation of the steel form

The specimens were constructed in the Structural Engineering Laboratory at the University of Manitoba. A steel form of a double T-beam, donated by Genstar Structures Ltd., was modified for casting of two single T-beams at a time. The cross-section of the modified form and an overall view of it are shown in Figure 3.21. The form was cleaned and lubricated with pella oil before the reinforcement cages were placed in it.

3.6.2 Preparation for casting

For each beam, the reinforcements were cut and bent into the proper designed dimensions and tied together after fixing the electrical resistance strain gauges. Typical reinforcement cages are shown in Figure 3.22. These cages were secured in the proper position inside the form by steel chairs. After prestressing the strands, the slab reinforcements were then placed on the plastic chairs and tied together to the reinforcement cages.

3.6.3 Stressing of prestressed strands

The prestressed strands were jacked against the abutments fixed on the structural lab floor (Figures 3.23 and 3.24). The strands were stressed one by one by means of hydraulic jack immediately prior to casting. The strain gauges attached to the strands were monitored during stressing and curing. To get the designed effective prestress force, the pressure of the hydraulic jack was up to 5400 psi based on the experimental results of A. Ray [45].

3.6.4 Casting of Concrete

The slump of the ready-mixed concrete was checked in order to facilitate placing before casting. Two hand-held vibrators were used when casting the concrete into the form. The vibrators were applied uniformly, especially inside the beam web, to achieve less honeycombing. After casting, the beams were cured by sprinkling water on them and covering them with plastic sheets for seven days. The prestress force was released at the eighth day by cutting the prestressed strands at the ends with oxyacetylene flames. The readings of the strain gauges on the strands were taken before and after the cutting to ascertain the existing prestress force. Then, the specimens were lifted from the form and cured in open air for at least 20 days before testing.

At each cast a total of 13 standard concrete cylinders of 152 mm diameter and 305 mm length were cast to determine concrete strengths. The compaction of the concrete cylinders was done with tamping rods and according to CSA standards. The cylinders were cured under the same conditions as the specimens to achieve similar concrete properties. Three cylinders were tested in compression at the day of releasing to ensure the proper strength of at least 66% of the designed strength before cutting the prestress strands. Five cylinders were tested at the day of testing for each beam, three of which were tested in compression and two in splitting. The cylinders were tested according to ASTM and CSA standards using a 300,000 lb. compression testing machine.

3.7 Test Set-Up

The testing was done using a 1000 kN MTS testing machine which applied load from above the specimen. The testing floor with the MTS machine and the H.P. Data Acquisition System is shown in Figure 3.25. Two concrete blocks of size 650 x 650 x 700 mm were designed to support the specimen, as shown in Figure 3.26. The elevation view of the test set-up is shown in Figure 3.27. Quick set plaster of paris mixed with water in a plastic packet was used between the beam web and steel shoes at the supports as well as between the square hollow steel sections and the beam flange at the load points to provide proper contact.

After the beam was properly aligned and levelled and the strain gauges and LVDT's were connected, the H.P. Data Acquisition System was run to zero-set LVDT's. The functioning of the strain gauges was checked. Then all the parameters were initialized.

3.8 Instrumentation

3.8.1 Steel strain measurements

The electrical resistance strain gauges were fixed both in prestressed and non-prestressed tensile reinforcements as well as in stirrups. The main principle for attaching strain gauges to the prestressed strands and for choosing the positions of the strain gauges was to achieve the following objectives: (a) to monitor the prestressing force during prestressing and curing time, and at the transfer; (b) to measure the stresses in the strands during testing; (c) to check for slippage. The purpose for attaching strain gauges on the longitudinal tension reinforcements was to measure the stresses on the reinforcements and to check the bond forces close to the possible diagonal cracking regions. The purpose of attaching strain gauges on the web reinforcements and for choosing the positions of the strain gauges were as follows: (a) to measure the strains on the stirrups; (b) to determine the distributions of the strains and stresses on the stirrups; and (c) to check the anchorages and slippages at ends and at crack crossing positions.

The types of gauges used were N11-FA-5-120-11 and N11-FA-5-350-11, manufactured by Showa Measuring Instruments Co., Ltd., Japan. The gauge length was 5 mm and the resistances of the gauges were approximately 120 ohms and 350 ohms, respectively. The procedure of attaching strain gauges comprised the following steps:

1. Surface Preparation

The surface was smoothed with grinding wheel and file (for deformed reinforcement), and fine sandpaper. Then the surface was thoroughly degreased with chlorothene. SM M-PREP conditioner A (Acid) was applied with cotton tips and wiped and dried. Then M-PREP Neutralizer 5 (Alkali) was used, wiped and dried in a similar way. These preparation procedures should be applied to an area significantly larger than that occupied by the gauge. Surfaces should be free from pits and irregularities.

2. Gauge Installation

A transparent tape (Mylar J9 Tape, JFG-2 for prestressed strands, PCT-2A cellophone tape for longitudinal reinforcements and stirrups) was used to carry the gauge and a solder terminal to the prepared surface. The bond-side of the gauge was wetted carefully with a small amount of Catalyst CA-200SL. One drop of M-bond adhesive (M-bond 610 for prestressed strands, M-bond 200 for the others) was put on the position of the strain gauge of the steel surface. The gauge was placed there very carefully with the help of the transparent tape. It was kept under uniform pressure for about five minutes with a thin cotton pad. The transparent tape was removed carefully when the gauge was attached on the surface of the reinforcement.

3. Heat Treatment

This step is only required for attaching strain gauges on the prestressed strands . The gauge was covered by a thin (0.070 mm thick, 12 mm wide) white teflon sheet, tied with 7 mm thick rubber pads and clamped properly. It was heated at about 162.5°C for two hours. The heating was done with high-temperature bulbs. The consistency of the temperature was monitored by the reading of a voltmeter graduated in millivolts. The standard table (in this case, Table IV) of "Temperature vs. Thermoelectric Voltage in Absolute Milivolt is given in Temperature Measurements Handbook, by Omega Engineering Inc. [39] .

4. Final Installation

The wires with the attached terminals were connected very carefully with the help of a Mark V Soldering Station. Both the workability and the resistances were tested using a digital multimeter. The M-coat D was applied on the gauge as well as on the terminal connections. The M-Coat G, which contains the combination of Resin and curing agent in the proportion of 1:2 by volume, was applied upon a relatively larger surface area to protect the gauge after the M-Coat D was completely dry.

The locations of the strain gauges on the longitudinal and transverse reinforcements for all the beams are shown in Figures 3.28 to 3.33, respectively. The strain gauges were connected to an H.P. 9825 Data Acquisition System and the strains in the reinforcements were recorded during testing.

3.8.2 Concrete strain measurements

To measure the concrete strains in the beam, stainless steel demec points were attached to the surface of the beam and two demec gauges (with gauge lengths of 200 mm and 8 in. (203 mm), respectively) were used. The positions of the demec points were chosen to determine the distributions of the concrete strains and cracks during testing.

150 mm x 100 mm pencil grids were made on the beam web by drawing horizontal lines at elevation 40, 240, and 340 mm from bottom. The positions of prestressed strands, longitudinal tension

reinforcements, transverse reinforcements, and strain gauge locations were marked in different colours with felt pens on the beam surface.

The arrangement of the demec points is shown in Figure 3.34. The 200 mm gauge was used on side A and 8 in. gauge on side B. The attachment was done by using 5 minute epoxy. The number of steps involved to fix the complete set of demec points on one side is shown in Figure 3.35. The number inside the circle indicates the number of the step to attach that demec point. The demec readings were taken manually with the demec gauges during testing.

3.8.3 Deflection measurements

To measure deflections and horizontal movements, a total of seven LVDT's were fixed on the specimen. The typical arrangement of LVDT's is shown in Figure 3.36. The three LVDT's fixed under the specimens were to measure the deflection at the mid-span and the two load points during testing. The others at supports were mainly to monitor the movements of the beam at supports. According to the data recorded from beams PSN1-0 and PSN2-WD and the results in A. Ray's thesis [45], the movements of the beam at supports were negligible. Thus the LVDT's at the supports were removed for the remaining four beams. The LVDT's were connected to the H.P. Data Acquisition System and the deflections were recorded during testing.

3.8.4 Data acquisition system

Load and downward displacements of the cross-head of the MTS machine (stroke) were monitored on the digital display of the

MTS machine and recorded continuously by an X-Y plotter. All the readings of the load, stroke, strain gauges and LVDT's were measured, recorded and printed by the H.P. Data Acquisiton System which consists of a controller (9825 B) digital mulimeter (3490A), scanner (3495A), and printer (9871A) as shown in Figure 3.37. Data were stored during testing on cassette tape cartridges.

3.9 Testing Procedure

The beams were loaded under displacement control to prevent any excess deflections due to the changes in stiffness during measurements. The load was applied in increments of 30 kN up to 120 kN, then 10 kN up to 150 kN to find the initiation of the flexural cracks. From 180 kN to 240 kN, 15 kN increments were used to determine the initiation of shear cracks. Then 30 kN increments were used until the beam failed. After each load increment, the displacement was held steady. The readings of loads, stroke, strain gauges and LVDT's were recorded by the H.P. Data Acquisition System. The lengths of the cracks were marked with felt pen and the end of the crack marked with the current value of the load so that the progression of cracks with load could be followed. At most of the load stages, the readings of the demec points were taken, and photographs of the crack pattern for pictures and slides were taken if they were visible.

CHAPTER 4

Test Results

4.1 Introduction

This chapter contains all the test results in detail for all the six specimens tested in this program. These results include material properties and tested beam strengths, mechanical readings of concrete strains (demec readings), readings of load, stroke, electrical strain gauges on the steels and LVDT's recorded by the Data Acquisition System, sketches and photographs of the crack patterns, and the observations during testing.

4.2 Recorded Data

Material properties and test results including the concrete strengths, applied loads corresponding to the initiation of the first flexural crack, diagonal crack and the ultimate load for each specimen are shown in Table 4.1. Mechanical strain readings for the average concrete surface on both sides A and B are shown in Tables 4.2. For each specimen, Table 4.2 is designated by the notation of the tested specimen; e.g., Table 4.2 - PSN1 is the mechancial strain readings (demec readings) for specimen PSN1-0. The readings in side A were taken by a gauge of 200 mm gauge length. One division of this gauge represents a strain of 8.07 x 10^{-6}. Similarly, the readings in side B were taken by the gauge of 8 in. (203.34 mm) gauge length. In that case, one division of that gauge represents a strain of 10.20 x 10^{-6}.

The recorded data of the load, stroke, electrical resistance strain gauges, and LVDT's are shown in Tables 4.3 for each specimen . The readings of the strains are in microns (10^{-6}) and those of the stroke and LVDT's are in mm . In order to prevent damage to the LVDT's, for beam PSN1-0 the LVDT's under the specimen were removed at a load level of 270 kN. However, the LVDT's at the supports were removed at a load of 360 kN. For beam PSN2-WD, all the LVDT's were removed at an applied load of 415 kN. The readings of electrical strain gauges W1 to W10 were lost for beam PSN2-WD due to the problem of incorrect channel number input to the Data Acquisition System. For beams PSN3-D2 to PSN6-WS, only the LVDT's underneath the specimen were used, and the LVDT's were removed at an applied load of 430, 420, 420, and 450 kN, respectively.

4.3 Observations During Testing

This section presents all the observations during testing. Sketches and photographs of crack patterns are shown in Figures 4.1 for each specimen. The measurement crack angles at different stations and different load levels on both sides are shown in Tables 4.4 for each specimen.

The following are brief descriptions of the observations recorded during testing for each specimen.

4.3.1 Specimen PSN1-0

a. Flexural cracks at the centre span initiated at an applied load (2P) of about 130 kN.

b. A significant diagonal crack formed in the shear span of side B at about 45° and a small diagonal crack initiated on side A at about 208 kN.

c. Two inclined cracks formed on the bottom part of side B at about 215 kN.

d. A significant diagonal crack formed at about 30° on side A at about 224 kN.

e. The significant crack on side B extended towards the two inclined cracks and a large shear crossing the whole web was formed at about 224 kN.

f. A small inclined crack formed on side B close to the support at about 270 kN.

g. The large diagonal crack on side B opened gradually as the load increased, but no further cracks formed.

h. Shear failure occurred suddenly at an applied load of 375 kN on side B.

4.3.2 Specimen PSN2-WD

a. Flexural cracks initiated at about 120 kN.

b. A diagonal crack initiated on each side at about 55° and 60° at 195 kN.

c. Another crack formed on each side at about 45° at 210 kN.

d. At the applied load of about 216 kN, an additional inclined crack initiated on each side.

e. An inclined crack formed at about 30° on side A at about 240 kN.

f. An inclined crack appeared at about 30° on side B at 255 kN.

g. Small cracks formed gradually towards the supports on both sides during load increasing.

h. After the applied load reached 330 kN, the major crack at about 30° on side B continued growing wider and wider, and no further cracks appeared.

i. Shear failure took place suddenly on side B at the applied load of 435.2 kN. Three vertical wires of the WWF crossing the failure crack were fractured as shown in Figure 4.2 - PSN2.

4.3.3. Specimen PSN3-D2

a. Flexural cracks initiated at an applied load (2P) of about 130 kN at the centre span.

b. A diagonal crack initiated on side A at about 210 kN.

c. A diagonal crack initiated on side B at about 225 kN.

d. A significant diagonal crack formed at about 30° on side A at 240 kN.

e. A significant inclined crack formed at about 30° on side B at 255 kN.

f. Small inclined cracks formed gradually towards the supports on both sides as the load increased.

g. On side B after the applied load was 360 kN, the significant inclined crack opened gradually and no further cracks formed on that side.

h. On side A small cracks continously initiated towards the support on the bottom parts of the beam up to 420 kN.

i. At about 500 kN, a few cracks appeared on the top of the beam slab at mid of the shear span of side B.

j. Shear failure took place suddenly on side B at 516.2 kN. A splitting crack formed between the web and slab from the load point up to the middle of the shear span of side B and three diagonal cracks formed from this splitting crack towards the support.

4.3.4 <u>Specimen PSN4-WDH</u>

a. Flexural cracks initiated at an applied load (2P) of about 120 kN at the centre span.

b. A flexure-shear crack initiated on side A at about 210 kN.

c. Two diagonal cracks on side B and one on side A formed at about 225 kN.

d. A significant inclined crack formed at about 23° on side A at about 240 kN.

e. A significant inclined crack formed at about 35° on side B at about 255 kN.

f. Small cracks continuously initiated towards the support on the bottom parts of the beam on both sides under load increasing up to 390 kN.

g. The significant inclined crack on side A opened gradually and seemed to dominate the failure.

h. Shear failure took place suddenly on side B at 494.2 kN. Three vertical wires of the WNF crossing the failure crack were fractured. The failure crack crossed over the connection of the additional horizontal wire at mid-height of the vertical wire, and the horizontal wire was broken in the weld as shown in Figure 4.2 -PSN4.

i. A splitting crack formed between the web and slab from the load point up to the middle of the shear span of side B, and a diagonal crack formed from that crack towards the support.

4.3.5 Specimen PSN5-S6M

a. Flexural cracks initiated at an applied load (2P) of about 120 kN at the centre span.

b. A flexure-shear crack initiated at about 60° on side A at about 210 kN.

c. A flexure-shear crack initiated at about 45° on side B at about 225 kN.

d. A significant inclined crack formed at about 30° on side A at about 240 kN.

e. Two inclined cracks formed at about 30° on side B at 255 kN.

f. A horizontal splitting crack appeared on the concrete cover of the top 20M tension rebars on side A and small inclined cracks extended from that splitting crack gradually towards the support up to 390 kN.

g. The significant crack together with the splitting crack on side A opened gradually as the load increased.

h. A big crack appeared on the top of the beam slab at the middle of the shear span of side B at about 475 kN.

i. Shear failure took place suddenly on side A at 507.7 kN.

j. A splitting crack formed between the web and slab from the load point up to the middle of the shear span of side B and a diagonal crack formed from this splitting crack up to the horizontal splitting crack.

4.3.6 Specimen PSN6-WS

a. Flexural cracks initiated at an applied load (2P) of about 50 kN at the centre span.

b. A flexure-shear crack initiated on side A at about 210 kN.

c. Another flexure-shear crack on side A and one on side B formed at about 225 kN.

d. Another diagonal crack initiated on side B at about 240 kN, and a significant inclined crack formed at about 35° on side A.

e. A significant inclined crack formed at about 30° on side B at about 270 kN.

f. Small cracks initiated continuously towards the support on the bottom part of the beam up to 390 kN.

g. The significant inclined crack on side B opened gradually and no further cracks appeared.

h. Shear failure took place suddenly on side B at 5075 kN.

i. A splitting crack formed between the web and slab from the load point up to the middle of the shear span of side B and one diagonal crack formed from that crack towards the support.

j. Three vertical wires of the WNF crossing the failure crack were fractured at the connections of the vertical wires and the additional horizontal wire at mid-height as shown in Figure 4.2-PSN6. (This WWF was obtained by cutting the mid-height wire).

CHAPTER 5

Discussion of Test Results

5.1 Introduction

This chapter includes the calculation of the concrete strains, crack widths and slides from the demec readings. Then it discusses the test results of the six specimens tested in this program. Computer programs originally written by Professor K. Maruyama are used to analyse and compare the test results of each beam to a total of twenty predicted values available in the literature. The flexural behavior and shear behavior of different specimens will be discussed in detail and compared to the various available models.

5.2 Calculations of Concrete Strains and Crack Widths

This section includes the calculations of the concrete strains, principal strains, crack widths and slides from the demec readings.

5.2.1 Concrete strains

Tables 5.1 show the concrete strains based on the demec readings for each specimen. The concrete strains were calculated based on the demec readings of a particular load stage minus the initial reading corresponding to zero load using the proper conversion factor. The conversion factors used were 8.07×10^{-6} and 10.20×10^{-6} for the 200 mm and 8 in. (203.34 mm), gauges respectively.

The principal concrete strains and the directions of principal strains for stations 11 to 18 (see Figure 3.34) were calculated using the measured horizontal strain, ε_H, vertical strain, ε_V, and diagonal strain, ε_D, using Mohr's circle as following:

$$e_1 = \frac{\varepsilon_H + \varepsilon_V}{2} + \sqrt{\left(\frac{\varepsilon_H - \varepsilon_V}{2}\right)^2 + \left(\varepsilon_D - \frac{\varepsilon_H + \varepsilon_V}{2}\right)^2} \quad (5.1)$$

$$e_2 = \frac{\varepsilon_H + \varepsilon_V}{2} - \sqrt{\left(\frac{\varepsilon_H - \varepsilon_V}{2}\right)^2 + \left(\varepsilon_D - \frac{\varepsilon_H + \varepsilon_V}{2}\right)^2} \quad (5.2)$$

$$\theta' = \frac{1}{2} \tan^{-1} \left(\frac{\varepsilon_H + \varepsilon_V - 2\,\varepsilon_D}{\varepsilon_H - \varepsilon_V}\right) \quad (5.3)$$

where e_1 = maximum principal tensile strain of concrete based on the demec readings

e_2 = minimum principal strain of concrete

θ' = direction of the maximum principal tensile strain with the horizontal axis of the specimen.

The principal strains and the directions of the maximum principal strains are given in Tables 5.2 for all the tested specimens.

5.2.2 Crack widths and slides

The definition of crack width in this study is the total crack width within the gauge length of the two demec points. The crack widths for stations 2 to 10 (see Figure 3.34) were calculated using the measured horizontal strain ε_H:

$$w = \ell\ (\varepsilon_H - \varepsilon_{co} - \varepsilon_{ct})\ \ (mm) \tag{5.4}$$

where w = total crack width within gauge length ℓ

ℓ = gauge length, 200.02 mm for side A,

203.34 mm for side B

ε_{co} = precompression strain of concrete due to prestressed force at that level

ε_{ct} = maximum tensile strain of concrete, 100 x 10^{-6}.

The crack widths for stations 11 to 18 could be calculated using different sets of demec readings in two directions with the measured crack angle as follows: (see Figure 5.1).

(a) Considering demec readings in horizontal and vertical directions only:

$$w_1 = \ell\ [(\varepsilon_H + \varepsilon_{co} - \varepsilon_{ct})\ \sin\theta + (\varepsilon_V - \varepsilon_{ct})\cos\theta] \tag{5.5}$$

where w_1 = crack width, mm

θ = measured crack angle to the horizontal axis of the specimen

(b) Considering demec readings in diagonal and vertical directions only:

$$w_2 = \ell[(\sqrt{2}\ \varepsilon_D - \varepsilon_V + \varepsilon_{co} - \varepsilon_{ct})\sin\theta + (\varepsilon_V - \varepsilon_{ct})\cos\theta] \tag{5.6}$$

where w_2 = crack width, mm

(c) Considering demec readings in diagonal and horizontal directions only:

$$w_3 = \ell[(\varepsilon_H + \varepsilon_{co} - \varepsilon_{ct})\sin\theta + (\sqrt{2}\,\varepsilon_D - \varepsilon_H + \varepsilon_{co} - \varepsilon_{ct})\cos\theta] \quad (5.7)$$

where w_3 = crack width, mm.

After cracking, the rigid body movement of cracked portions of the specimen involved the following two components as shown in Figure 5.1: (a) the crack width, w, which is perpendicular to a crack surface, and (b) the slide, S, which is the movement along the crack surface. In a similar way as the calculation of crack width, the values of slides along the crack surface could be calculated using the different sets of demec readings with the measured crack angles as follows:

(a) Considering demec readings in vertical and horizontal directions only:

$$S_1 = \ell[(\varepsilon_H + \varepsilon_{co} - \varepsilon_{ct})\cos\theta - (\varepsilon_V - \varepsilon_{ct})\sin\theta] \quad (5.8)$$

where S_1 = value of slide, mm

(b) Considering demec readings in diagonal and vertical directions only:

$$S_2 = \ell[(\sqrt{2}\,\varepsilon_D - \varepsilon_V + \varepsilon_{co} - \varepsilon_{ct})\cos\theta - (\varepsilon_V - \varepsilon_{ct})\sin\theta] \quad (5.9)$$

where S_2 = value of slide, mm.

(c) Considering demec readings in diagonal and horizontal directions only:

$$S_3 = \ell[(\varepsilon_H + \varepsilon_{co} - \varepsilon_{ct})\cos\theta - (\sqrt{2}\,\varepsilon_D - \varepsilon_H + \varepsilon_{co} - \varepsilon_{ct})\sin\theta] \quad (5.10)$$

The crack widths and slides for stations 11 to 18 could also be calculated using the principal strains and the directions of the principal strains. Usually, the directions of the maximum principal strains with the horizontal axis of the member based on the measured demec readings were not perpendicular to the cracks. The crack angles to the horizontal axis of the specimens were measured, thus the angles for calculation the crack widths were modified as shown in Figure 5.1. The following expressions were derived to calculate the crack widths:

$$w = \ell\ (\varepsilon_1 \cos \alpha^* + \varepsilon_2 \sin \alpha^*) \tag{5.11}$$

$$\varepsilon_1 = e_1 - \varepsilon_{ct} + \varepsilon_{co} \cos \theta' \tag{5.12}$$

$$\varepsilon_2 = e_2 - \varepsilon_{ct} + \varepsilon_{co} \sin\theta' \tag{5.13}$$

where ε_1 = maximum principal strain with the influences of the precompression strain, ε_{co}, and the maximum tensile strain, ε_{ct}

ε_2 = minimum principal strain with the influences of the precompression strain and the maximum tensile strain

e_1 = maximum principal tensile strain of concrete based on the demec readings

e_2 = minimum principal strain of concrete

θ' = direction of the maximum principal tensile strain with the horizontal axis of the specimen

α^* = modified crack angle as shown in Figure 5.1

In the same way, the values of slides along the crack surface could also be calculated using the principal strains with the following expression:

$$S = \ell\ (\varepsilon_1 \sin \alpha^* - \varepsilon_2 \cos \alpha^*) \qquad (5.14)$$

where S = value of slide along the crack surface.

A computer program was used to calculate the crack widths and slides based on the demec readings with the above expressions. Tables 5.3 show the computed crack widths at different stations for all the tested beams. Tables 5.4 present the calculated values of slides.

5.3 Flexural Behavior

5.3.1 Calculated flexural strengths

The flexural strength of all the specimens was predicted using the idealized stress-strain curve of concrete as shown in Figure 3.11. An average compression strength of 34.3 MPa based on the ultimate strengths of the concrete cylinder tests was used for all the tested specimens. The ultimate compressive strain, ε_{co}, was assumed to be 3500 x 10^{-6}. The ultimate tensile strain, ε_{ct}, was assumed as 100 x 10^{-6}. The compression concrete strain, ε_{co}, corresponding to the maximum compression strength was assumed to be 2000 x 10^{-6}, as shown in Figure 3.11.

The yield strain of the prestressed strands was assumed to be 8560 x 10^{-6}. The stress-strain relationship after yielding was assumed as follows:

$$f_p = f_{py} + \frac{4(f_{pu} - f_{py})(\varepsilon_p - \varepsilon_{py})}{(\varepsilon_{pu} + 3\,\varepsilon_p - 4\,\varepsilon_{py})} \qquad (5.15)$$

$$f_{py} = E_p\,\varepsilon_{py} \qquad (5.16)$$

where f_p = stress of the prestressed strand, MPa

f_{py} = yield stress of prestressed strand, MPa

f_{pu} = ultimate stress of prestressed strand, 1860 MPa

ε_p = strain of the prestressed strand

ε_{py} = yield strain of prestressed strand, 8560 x 10^{-6}

ε_{pu} = ultimate strain of strain, 50000 x 10^{-6}.

An effective prestress force of 220 KN was also used based on the average prestress loss of 17.6% [45]. The relationship of moment-curvature calculated using a computer program is shown in Table 5.5. A typical curve of the applied shear force-curvature relationship is shown in Figure 5.2. The predicted total applied load (2P) corresponding to the initiation of the first flexural crack was 148.4 kN. The flexural strength of the specimens was 331 kN.m and the corresponding total maximum applied load (2P) was 575.2 kN. The bottom longitudinal reinforcement yielded at an applied load of 477.8 kN.

Figure 5.3 shows the predicted and the experimental results of the responses of the applied load to the strains in the bottom longitudinal bar based on the recorded strain gauge readings. The trends of the curves for the specimens, except that for beam PSN1-0, agreed very well with the predicted values. The same appearance could be obtained using the strain gauge readings on the prestressed strands. The phenomenon of the curve for beam PSN1-0 is believed to be due to the localization of the small strain gauge.

5.3.2 Flexural cracking

The values of ultimate tensile strength were predicted according to ACI Code [1]:

$$f_{ct} = 0.5\sqrt{f'_c} \tag{5.17}$$

where f_{ct} = ultimate tensile strength of concrete

f'_c = compressive strength of concrete.

From the test results, the predicted value of applied load corresponding to the initiation of the first flexural crack for beam PSN6-WS was exactly the same as that from the test. For the others, the predicted value was overestimated in a range of 12.6% to 19.3% of the experimental results (see Table 4.1). One reason for this difference is the idealized bi-linear response of the tensile stress-strain of the concrete as shown in Figure 3.11.

For all the beams, the propagation of flexural cracks at the middle span of the beams was typically vertical. After the initiation of the diagonal cracks on the shear spans, the rate of the propagation was significantly reduced. From Figures 4.1-PSN1 to 4.1-PSN6, and Tables 5.3-PSN1 to 5.3-PSN6, the flexural crack patterns, in terms of the number of flexural cracks and crack width, were similar. Thus, the type of shear reinforcement has no significant influence on the flexural crack patterns.

5.3.3 Stiffnesses of beams

Stiffnesses of the beams were studied using the recorded load-stroke response and load-deflection responses of the beams. The load-stroke response, the load-deflection responses at mid-span and under the load point of the failure spans of all the tested beams are shown in Figures 5.4 to 5.6,respectively.

The load-deflection behavior of all the beams was very similar up to an applied shear of 105 kN, which corresponded to the initiation of the first diagonal shear cracks of the beams. The stiffnesses of the beams reduced significantly after the initiation of the diagonal shear cracks. From Figures 5.4 to 5.6 the deflection of beam PSN1-0 without web reinforcement increased rapidly after initiation of the shear cracks compared to beams with web reinforcements. And beam PSN1-0 failed with the maximum displacement of the stroke of 16.5 mm. Thus web reinforcement increased the stiffness and ductility of the beams.

The stiffness of beam PSN6-WS was the highest compared to the others. From Figures 5.4 and 5.5 the beams with WWF as shear reinforcements were slightly higher than the beams with conventional stirrups in terms of stiffness.

The different appearance of Figures 5.5 and 5.6 was due to the fact that the differences of the deflections under the two load points were different. The differences were very significant for some beams, but for others they were negligible. For beam PSN2-WD, failure took place with a considerably lower value of deflection than that of the others with shear reinforcements. This is believed to be due to the lowest value of ductility of the vertical wires of that WWF mesh. Beam PSN4-WDH showed that the additional longitudinal wire at the mid-height did not increase the stiffness of the beam. One reason that the stiffness of beam PSN4-WDH was slightly lower than that of beam PSN2-WD and beam PSN6-WS as shown in Figure 5.5 was considered as the lowest concrete strength of that beam. But the additional longitudinal wire did increase the ductility of the beam.

5.4 Shear Behavior

5.4.1 Predicted shear strength

There are many empirical relations in the literature for estimating the diagonal cracking load and the ultimate shear strength of beams. Several design codes and proposed equations considered to be the most suitable to this research program have been used to estimate the shear strength of beams with or without web reinforcement. The discussions and explanations of these design methods are in Chapter 2.

Tables 5.6 and 5.7 show the typical calculated values of the shear strength by twenty different methods discussed in Chapter 2. Column 2 of these tables contains the predicted values of shear strength contributed by concrete. Column 3 contains the predicted values of ultimate shear strength. Column 4 contains ratios of the tested shear strength corresponding to the first diagonal crack initiation to the predicted shear strength contributed by concrete. Column 5 contains ratios of the tested ultimate shear capacity of specimen PSN1-0 without web reinforcement, which was 187.5 kN, to the predicted shear strengths contributed by concrete. Column 6 contains ratios of the tested ultimate shear capacity of that beam (see Table 4.1) to the predicted ultimate shear strength.

Method 1 was by the JSCE recommendations [23] without the strength reduction factors γ_b and γ_c. Method 2 used the strength reduction factors for equation (2.51) in order to examine the conservativity. Method 3 was proposed by Okamura and Higai [39] with equation (2.56). Method 4 was by Niwa [38] with equation (2.57). Methods 5 and 6 were according to the Simplified Method of the CSA Code [13] for reinforced concrete beams with axial forces and for prestressed concrete members, respectively. The material factor for concrete, ϕ_c. was 0.6. Methods 7 and 8 were the Simplified Methods of the CSA Code with ϕ_c as unity. Methods 9 to 12 were according to the ACI Code [1]. Method 13 was proposed by Zsutty [56]. Methods 14 and 18 were by Placas and Regan [41]. Method 15 was by Rajagopalan and Ferguson [43]. Method 18 was by Matlock [20] and Method 17 was according to CEB/FIP Code [15]. For Methods 1 to 16, the contribution of the web reinforcement was predicted by the 45° truss model.

Method 20 was according to the General Method of the CSA Code [13]. Tables 5.8 and 5.9 present the typical calculated values by the general method using a computer program written by Professor Maruyama. Columns 1 and 8 of these tables show the principal strains of concrete at mid-depth of the beams. Columns 2 and 6 contain values of the applied shear and the applied moment at critical section, respectively. Column 3 contains angles of the inclination of the principal compressive stresses. Column 4 contains stresses in the web reinforcement. Column 5 contains strains in the web reinforcement. Column 7 contains the crushing strength of the diagonal concrete struts. Column 9 contains axial concrete strains at mid-depth of the beams. Column 10 contains concrete strains in the top fibers. Column 11 contains the net axial forces.

Figures 5.7 and 5.8 are typical histograms for the comparison of the predicted shear strength using the above mentioned 20 methods and the experimental results. Figure 5.9 shows the comparison of the ratios of the tested result to the predicted shear strengths by the 20 methods.

5.4.2 Comparison of predicted and experimental values

From Tables 5.6 to 5.9 and Figures 5.7 to 5.9 it is clear that the ACI and CSA approaches provide the best predictions to the experimental results for this research program. Table 5.10 shows the estimated shear strengths according to the ACI Code and the experimental test results of the shear strengths of the six tested specimens. Figures 5.10 and 5.11 show the histograms of the predicted and tested shear strengths.

The predicted nominal shear strengths provided by the concrete when diagonal cracking results from excessive principal tensile stress in the web by ACI Code and CSA Code are very close to the tested values of applied shear force corresponding to the first initiation of the diagonal cracking. The ultimate shear capacity of the beam PSN1-0 without web reinforcement was 80% higher than the shear strength provided by the concrete when diagonal cracking initiated. The reasons for this phenomenon are that the shear span to depth ratio a/d was less than 3, that the arch action becomes more dominant, and the ratio of flange width to web width, b_f/b_w was very large (b_f/b_w = 5.91) [3]. Thus, the Codes underestimated the contribution of concrete.

The ultimate shear capacity of the tested beams with web reinforcement were 53% to 83% higher than the predicted shear strenghts by ACI and CSA Codes. One reason is that the angles of the major diagonal crack to the axes of the beams were about 25° to 35°. Thus, the Codes using a 45° truss model also underestimated the contributions of the web reinforcement.

The General Method of the CSA Code underestimated the ultimate shear strength of the beams between 90% to 148%. The reason of that is the amounts of shear reinforcement used were very low [16]. The comparison of the relationships between amounts of shear reinforcement and shear strength predicted by the General Method of CSA Code and ACI Code is shown in Figure 5.12 [16].

5.4.3 Stirrup strains

The electrical resistance strain gauges attached on stirrups for different beams are shown in Figures 3.27 to 3.31. The readings of the strain gauges recorded by the Data Acquisition System are shown in Tables 4.3-PSN2 to 4.3-PSN6. From these tables, it can be seen that the strains in the stirrups were negligible before diagonal cracks crossed the stirrups. After diagonal cracks crossed the stirrups, the readings of the strain gauges in the stirrups were dependent on the relative positions of the cracks to the strain gauges and on the crack widths. Typical strain distributions in the stirrups are shown in Figure 5.13.

While increasing the applied load, the sudden reduction of strain could be used as an indicator for the loss of bond or anchorage in the stirrups. From Figure 5.13 and Tables 4.3, there was no sudden reduction of strain readings before failure took place. Thus, the two horizontal wire anchorages of the WWF were sufficient.

From Tables 4.3, all the stirrups of the beams PSN2-WD, PSN3-D2, PSN4-WDH, PSN5-S5M, and PSN6-WS crossed by the diagonal cracks yielded at an applied shear force of 195, 165, 195, 195, and 225 kN, respectively. The reason that the stirrups of the beam PSN3-D2 yielded earlier is that the yielding strain of the double-legged stirrups was smaller than those of the other types of stirrups. These test results indicate that the two horizontal wire anchorages of the WWF meshes were sufficient and the shear reinforcements of these tested beams were effective. From the crack patterns shown in Figures 4.2, the failure shear cracks of the beams crossed at least 5 stirrups. But according to the 45° truss model used in the Codes, only 2.6 stirrups could contribute to the shear transfer. Accordingly, the Codes predict only one half of the contribution of shear reinforcement for these types of beams.

5.4.4 Crack patterns

The crack patterns of all the beams are shown in Figures 4.1. The number of diagonal cracks at the mid-height of the beam was 4, 9, 6, 9, 6, and 7 for beams PSN1-O, PSN2-WD, PSN3-D2, PSN4-WDH, PSN5-S6M, and PSN6-WS respectively. The distributions of the cracks along the beams PSN2-WD and PSN4-WDH with deformed WWF meshes were the most uniform. The distribution of the cracks of the beam PSN5-S6M was worst compared to that of other beams with web reinforcement in terms of uniformity. The reason could be attributed to the fact that the concrete covers of the two top 20M longitudinal bars were slightly smaller than that of the other beams because of the standard bottom hooks of the single-legged stirrups (see Figure 3.6). A horizontal splitting crack about 500 mm long extending from the diagonal crack parallel to the longitudinal bars was formed on side A. And no further diagonal cracks were formed up to failure. From Figures 4.1, the confinement of shear reinforcement caused an increase in the number of cracks and the crack patterns to be well distributed. As far as the number and the distribution of the diagonal cracks were concerned, the beams with deformed WWF meshes were the best. The additional longitudinal wire on the WWF had no influence to the crack pattern. And the beam with smooth WWF showed no significant inferior in comparison to the beams with conventional stirrups.

5.4.5 Crack width

In this program, the total average crack width within the demec gauge length will be used to study the cracking behavior rather than the crack width of the individual crack. From the test results and the previous research by A. Ray [45], the trend of the total average crack width within the demec gauge length agreed very well with the actual measured crack width of the single crack. The crack widths calculated from the demec readings are shown in Table 5.3. For the stations 11 to 18 (see Figure 3.34), the total average crack width was calculated based on the average of the four values, w, w_1, w_2, and w_3 described in Section 5.2.2. Figure 5.14 shows the response of the applied shear load and the maximum crack widths of the six tested beams. The maximum crack width for each applied load was calculated by comparing the crack widths of the 35 stations on the concrete surface in each load stage (see Figure 3.34).

Figure 5.15 shows the curves of the applied shear-total crack widths of the six tested specimens. The total crack width was the summation of the crack widths of the 35 demec stations in each load level. The number and the position of the demec stations were designed to cover all the concrete surface where cracks would form. The crack width and slide along the crack surface as shown in Figure 5.1 represent the relative movement of the two portions of the beam. The total relative movement inside the beam at each load stage was based on the summation of the crack widths and slides of the 35 demec stations. From Tables 5.3 and 5.4, the values of slides were found to be much smaller in comparison to the crack width . Thus the total relative movement inside the beam could be accounted only by the total crack width without consideration of the slide of the crack.

From Figures 5.14 and 5.15, the maximum crack width and the total crack width of all the beams were essentially the same before the initiation of diagonal shear cracks. Thus as expected, the shear reinforcement has no influence on the flexural crack width. After the initiation of diagonal cracks, the maximum crack width and the total crack width of beam PSN1-0 without web reinforcement were much greater than that of beams with shear reinforcement . Thus, it is well known that the shear reinforcement transfers the applied shear force as well as confines the concrete. When the applied load was increased, from 104 kN to 112 kN, the maximum crack width and the total crack width of beam PSN1-0 increased significantly. As the load was increased no further significant cracks were formed and the rate of increase of maximum crack width and total crack width was reduced for beam PSN1-0. It is believed the applied load was transferred by the arch mechanism.

For the beams with shear reinforcement , the maximum crack widths were almost the same up to the applied shear, P , of 135 kN. Accordingly, the type of web reinforcement has no significant influence on the maximum crack widths of the beam during the formation of the diagonal cracks. From Figure 5.14, at an applied shear of 120 kN, the maximum crack widths of beam PSN4-WDH, PSN3-D2 and PSN2-WD were slightly greater than that of the other two beams with web reinforcements. The reason is due to the fact that quite a few cracks formed at that stage for these three beams. After an applied shear of 135 kN, beams PSN6-WS and PSN3-D2 had the smallest maximum crack widths. This behavior could be attributed to the larger amounts of shear reinforcement, $\frac{A_v f_{vy}}{b_w s f'_c}$, used in comparison to the other beams (see Table 5.10). Beam PSN5-S6M had the largest maximum crack width, which could be due to the relatively small amount of shear reinforcement used in this beam. From Figure 5.15, the same trend could be found. Beams PSN3-D2 and PSN6-WS showed superior, and beams PSN4-WDH and PSN5-S6M showed inferior in terms of total crack width. Thus it can be concluded that the maximum crack width, or in general, the total crack width of the beams with shear reinforcements is strongly dependent on the amount of shear reinforcement after the formation of diagonal cracks. The maximum crack widths of beams PSN2-WD and PSN4-WDH were almost the same. The total crack width of beam PSN4-WDH was even greater than that of beam PSN2-WD, Since the ultimate concrete strength of beam PSN4-WDH was the lowest of the six beams while that of beam PSN2-WD was the highest (see Table 4.1). Thus, the additional horizontal wire at the mid-height of the beam in WWF made no improvement in terms of maximum crack width and total crack width. From Figures 5.14 and 5.15, the beams with WWF showed no inferiority in terms of maximum crack width and total crack width in comparison to the beams with conventional stirrups.

5.4.6 Failure mechanism

From the observations during testing and the crack patterns shown in Figures 4.1-PSN1 to 4.2-PSN6, diagonal shear cracks initiated in each shear span at about 45° to 65° to the axis of the beams as the load increased. For beam PSN1-0 without web reinforcement the diagonal crack on side B propagated up to the load point and down to the bottom of the beam at the support. The beam began to deflect rapidly, and the flange kinked in the region near the load point of side B. Suddenly the segment farthest from side B dropped down relative to the segment of side B and failure occurred.

For beams with shear reinforcement, after the initiation of diagonal shear cracks the confinement of shear reinforcement caused further diagonal cracks to form with flatter angles down to 25°, and the crack widths were much smaller in comparison to the beam without web reinforcement (see Figure 5.14). For beam PSN2-WD, as the major crack on side B widened, the vertical wires of WWF crossed by the crack began to yield. Due to the lack of ductility and yielding plateau of such wire mesh (see Figure 3.18), three vertical wires crossed by the cracks were fractured. Then shear failure suddenly took place.

For the other four beams with shear reinforcement , as one of the major cracks widened and the stirrups crossed by that crack yielded,stress redistribution took place inside the beams. As the load increased, deflection increased rapidly, and the flange kinked downwards in the region near the load point. Transverse cracks formed across the top of the flange at the central region of the failure shear span. The failure cracks propagated up to the load point and down to the bottom of the beams at the support. The bottom anchorages of stirrups close to the support and the top anchorages of the stirrups close to the load point were damaged and the load transferred by these stirrups dropped significantly. Thus the tension force in the remaining stirrups crossed by the failure crack increased suddenly. For beams PSN4-WDH and PSN6-WS with WWF, three vertical wires were fractured. For the other two beams with conventional stirrups, it was observed that the anchorages of the rest of the stirrups crossed by the failure crack were damaged. Thus, the stresses in the concrete caused to form the horizontal crack from the failure crack along the transition of the web and flange and additional diagonal cracks from that horizontal crack in the upper region of the web near the support (see Figures 4.1). Then the segment farthest from the support of the failure side dropped and failure took place.

From Figure 5.4, the area under the load-stroke curve is considered as input energy that the beam had absorbed. The energy absorbed before the initiation of diagonal cracks was identical for all the beams at any load level. At failure, beam PSN1-0 absorbed much less energy in comparison to the beams with shear reinforcement . Accordingly,the shear reinforcement increases the absorbency of energy of the beam. Before failure beam PSN2-WD absorbed exactly the same amount of energy as beams PSN3-D2, PSN4-WDH, and PSN5-S6M did at any load level. Because of the brittle nature of the vertical wires in beam PSN2-WD (See Figure 3.18), it absorbed much less energy than the other beams with web reinforcement. Thus, it is believed that if the ductility of the vertical wire is less than a certain limit, the absorbency of energy of the beam will be reduced. From Figure 5.4, the amounts of energy that the other two beams with WWF absorbed were the same as, or even slightly greater than (PSN6-WS), that of the beams with conventional stirrups at failure. Accordingly if the ductility of the vertical wires is greater than a certain limit, the absorbency of energy of the beam with WWF as shear reinforcement is the same as that of the beams with conventional stirrups. From the test results, the ductility of WWF meshes in beams PSN4-WDH and PSN6-WS is sufficient.

5.4.7 Comparison of beam strength

From Table 5.10 and Figures 5.10 and 5.11, the tested values of applied shear corresponding to the first initiation of the diagonal cracking of all the beams, except beam PSN2-WD, were exactly the same. For beam PSN2-WD, the tested value was only 7% lower than that of the others. This could be attributed to the scattered test results of shear behavior. The tested ultimate shear strength of beam PSN3-D2 with double-legged stirrups was the greatest because it had the largest amount of shear reinforcement. The effectiveness of shear reinforcements in beams PSN4-WDH and PSN6-WS with WWF as concerned the ultimate shear strengths was greater than that of the double-legged stirrups in beam PSN3-D2 and lower than the single-legged stirrups in beam PSN5-S6M. But the variation was very small (see Figure 5.11 and Table 5.10). The ultimate strength of beam PSN2-WD with WWF was considerably lower in comparison to that of the other beams with shear reinforcement. This is attributed to the lack of ductility of that WWF. Accordingly, the effectiveness of WWF is the same as that of conventional stirrups in the sense of utlimate shear strength.

CHAPTER 6

Conclusion

6.1 Conclusion

The objective of this research program was to evaluate the effectiveness of welded wire fabric as shear reinforcement in comparison to conventional stirrups for thin-webbed prestressed T-beams under static loading. A total of six pretensioned prestressed single T-beams with identical flexural reinforcement and shear span-to-depth ratio were tested statically up to failure. The tested beams featured different types of shear reinforcement including conventional double-legged, single-legged, and three different types of commercially available welded wire fabric (WWF). A beam without any web reinforcement was also included in this program. All beams were designed with a nominal flexural strength higher than the shear strength. Based on the test results, the following conclusions may be drawn:

1. ACI Code and the Simplified method of the Canadian Code provide the best prediction of the shear strengths for this type of beam. Because of the low amounts of shear reinforcement, the General Method of the Canadian Code underestimates the ultimate strength of the beams.

2. The prestressed T-beams in this study failed with diagonal shear cracks at an inclination generally less than 30° to the horizontal axis of the beam. The concrete shear strength corresponding to the initiation of diagonal cracks was exactly the same as the Code's predictions.

3. The ultimate shear strength of the beam without shear reinforcement was 80% greater than the shear strength corresponding to the initiation of the diagonal cracks because the shear span-to-depth ratio (2.91) was less than 3, arch action dominated failure, and the ratio of flange width-to-web width of the beam was very large (5.91).

4. Because of the shallow angle of the shear cracks, more vertical wires were effective in shear transfer than considered by the 45° truss model in the Codes. The contribution of shear reinforcement, V_s, was almost twice the Code prediction. Accordingly, the ultimate shear capacity of the tested beams with web reinforcement was 53% to 83% higher than the Code predictions.

5. The type of shear reinforcement has no influence to the flexural cracking patterns. The maximum crack width and the total crack width of all the beams were essentially the same up to the applied shear of 135 kN. At higher load levels, the maximum crack width and the total crack width were influenced by the amount of shear reinforcement.

6. The stiffness of all the beams was identical up to the initiation of diagonal shear cracks. After shear cracking initiated, beams with welded wire fabric were slightly than that of the beams with conventional stirrups in terms of stiffness of beams.

7. Anchorage of the welded wire fabric by means of double horizontal wires at top and bottom of the vertical web wires as recommended in the code was sufficient.

8. Using deformed WWF slightly improved the distribution of the diagonal cracks in comparison to the conventional stirrups. The effectiveness of WWF was almost the same as that of conventional stirrups in terms of the maximum crack width, total crack width, and the shear strength of the beams.

9. The presence of an additional horizontal wire at the mid-height of the WWF mesh did not have significant influence on the crack pattern, maximum crack width, total crack width, and the stiffness of the beam. But it did enhance the ductility of the WWF mesh itself as well as the ductility of the beam and the ultimate shear strength of the beam.

10. The dissipated energy was almost the same for all the beams (except beam PSN2-WD) with shear reinforcement. Three vertical wires of all the WWF meshes crossed by the failure crack fractured at failure due to the relatively low ductility. Accordingly, it is concluded that if the ductility of the vertical wires is greater than a certain limit, the absorbency of energy of the beams with WWF as shear reinforcement is the same as that of the beams with conventional stirrups.

6.2 Suggestions for Future Reearch

1. Because of the many factors affecting shear strength and serviceability of beams, more research should be performed on T-beams while varying such parameters as: shear span-to-depth ratio, a/d, spacing, s, flange width-to-web width ratio, b_f/b_w, and the amount of shear reinforcement, to evaluate the effectiveness of welded wire fabric as shear reinforcement.

2. Research is required on similar T-beams under cyclic loading conditions. This would give valuable information about how the weld reduces the strength of the wire, the possible defects of WWF as shear reinforcement such as bond, anchorage, ductility, and confinement of concrete.

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Table 2.1 ASTM and CSA Standards for Welded Wire Fabric (WWF)

ASTM Standard	CSA Standard	Title
ASTM A 82	CSA G30.3	Cold-drawn Steel Wire for Concrete Reinforcement
ASTM A 185	CSA G30.5	Welded Steel Wire for Concrete Reinforcement
ASTM A 496	CSA G30.14	Deformed Steel Wire for Concrete Reinforcement
ASTM A 497	CSA G30.15	Welded Deformed Steel Wire Fabric for Concrete Reinforcement

Table 3.1 Properties of longitudinal Reinforcements

Type of Reinforcement	Area (mm^2)	Yield Strength (MPa)	Ultimate Strength (MPa)	Ultimate Elongation (%)	Modulus of Elastisity (MPa)
1/2 in. 7-Wire Prestressed Strand	99	1560*	1823	6.5	1.95E5
20M-400MPa Deformed Bar	300	434	679	11.5	2.04E5
15M-400MPa Deformed Bar	200	437	698	11.3	2.04E5
#3 Deformed Bar	73.72	432	593	29.5	1.91E5
4x4 W4xW4 Welded Mesh	25.8	600	726	7.3	2.00E5

*Value corresponding to 1% of extension.

Table 3.2 Properties of Shear Reinforcements

Beam	Type of Shear Reinforcement	Size (Area) (mm^2)	Spacing (mm)	Yield Strength fvy (MPa)	Ultimate Strength fvu (MPa)	Ultimate Elongation (%)	Shear Reinforcement Ratio Pv=Avfvy/(fc'bws)
PSN1-0	None	-	-	-	-	-	-
PSN2-WD	WWF	D4.7 Deformed (28.4)	152	587*	587	6.0	0.00291
PSN3-D2	Double-Legged Stirrup	#2 Smooth (61.22)	150	344	510	28.0	0.0372
PSN4-WDH	WWF	D4.7 Deformed (28.4)	152	593*	603	6.0	0.0294
PSN5-S6M	Single-Legged Stirrup	6mm Deformed (31.17)	150	483*	693	10.5	0.0266
PSN6-WS	WWF	W4.7 Smooth (30.58)	152	578*	618	8.5	0.0308

*Yield strength computed according to clause 3.5.3.2 of ACI 3118M-83

Table 4.1 Concrete Properties and Test Results

Beam	Slump (mm)	fc at 7-Day (MPa)	Age (Days)	fc' (MPa)	fsp (MPa)	Flexural Crack Initiation (2P) (KN)	Shear Crack Initiation (2P) (KN)	Ultimate Load (2P) (KN)
PSN1-0	60	24.9	40	36.1	3.30	130	208	375
PSN2-WD	60	24.9	42	38.1	4.00	120	195	435.4
PSN3-D2	100	25.2	36	33.3	3.63	130	210	516.2
PSN4-WDH	100	25.2	30	31.5	3.39	120	210	494.2
PSN5-S6M	105	24.4	28	32.5	3.29	120	210	507.7
PSN6-WS	105	24.4	33	34.3	3.08	150	210	507.5

Table 4.2-PSN1 Concrete Demec Readings for Beam PSN1-0

SIDE A

STATION	APPLIED SHEAR (KN)	0.0	30.0	60.0	75.0	90.0	105.0	112.0	120.0	127.5	135.0	142.5
		Demec Readings										
2		900	907	911	912	914	913	937	946	956	969	985
3		928	935	948	951	951	957	1037	1073	1090	1098	1114
4		913	918	928	932	945	961	1025	1060	1075	1082	1095
5		893	912	922	936	947	958	981	1005	1015	1022	1029
6		857	877	900	923	955	1003	1018	1052	1069	1085	1094
7		957	956	952	957	955	951	940	942	936	930	928
8		825	824	827	826	822	823	807	802	800	795	786
9		882	882	882	880	884	882	948	1015	1044	1074	1101
9A		893	892	894	895	902	925	980	975	979	976	979
10		906	922	946	972	1001	1018	1027	1058	1077	1091	1110
	H	891	893	898	897	902	902	868	855	844	843	843
11	V	970	970	969	970	970	970	1443	1716	1859	2018	2170
	D	900	904	905	909	910	913	1448	1722	1876	2034	2190
	H	889	894	901	902	904	902	1082	1183	1239	1297	1347
12	V	985	987	983	985	984	988	1591	1885	2047	2209	2369
	D	918	923	927	930	934	936	1561	1755	2019	2182	2343
	H	902	908	916	919	928	926	995	1010	1016	1025	1031
13	V	894	891	890	892	895	916	1459	1705	1850	1989	2125
	D	909	913	920	922	931	978	1586	1868	2026	2179	2332
	H	965	970	984	985	995	1055	1055	1066	1074	1077	1086
14	V	885	881	879	881	880	910	1026	1024	1030	1032	1043
	D	950	955	959	961	974	1051	1164	1173	1180	1184	1199
	H	957	959	961	960	963	961	937	929	921	917	912
15	V	984	983	984	985	985	986	983	979	976	894	992
	D	931	932	936	939	941	943	936	934	927	928	928
	H	859	861	864	865	866	862	838	823	819	817	811
16	V	888	888	889	888	887	890	1369	1650	1801	1951	2098
	D	949	950	956	961	957	953	1478	1758	1913	2061	2206
	H	894	895	901	903	913	910	1072	1178	1231	1284	1341
17	V	883	883	883	880	883	878	1315	1537	1662	1776	1884
	D	1006	1013	1015	1020	1020	1071	1564	1809	1940	2066	2198
	H	884	890	897	903	915	968	1020	1023	1027	1029	1036
18	V	921	919	917	915	913	949	1065	1074	1081	1090	1097
	D	1889	1890	1899	1902	1915	1981	2099	2006	2114	2119	2129

Table 4.2-PSN1 Concrete Demec Readings for Beam PSN1-0

SIDE B

Demec Readings

STATION	APPLIED SHEAR(KN)	0.0	30.0	60.0	75.0	90.0	105.0	112.0	120.0	127.5	135.0	142.5
2		1025	1026	1029	1029	1031	1031	1068	1080	1090	1099	1011
3		999	1002	1007	1010	1012	1029	1047	1057	1063	1063	1069
4		1068	1073	1080	1084	1090	1138	1159	1173	1181	1189	1207
5		1015	1023	1031	1036	1046	1090	1105	1125	1135	1143	1153
6		1018	1028	1045	1068	1087	1108	1120	1141	1152	1166	1180
7		992	992	992	992	992	987	980	979	979	973	972
8		1050	1046	1045	1043	1044	1031	1022	1015	1012	1008	1005
9		972	971	969	970	973	1028	1096	1131	1154	1177	1207
9A		1015	1013	1013	1016	1015	1022	1027	1031	1035	1034	1037
	H	1022	1023	1024	1026	1028	1020	993	989	976	968	960
11	V	1005	1004	1004	1005	1004	1025	1579	1805	1977	2157	2368
	D	1042	1045	1045	1046	1049	1104	1639	1857	2019	2187	2383
	H	1012	1013	1019	1021	1022	1060	1210	1281	1322	1366	1422
12	V	994	995	993	994	993	1202	1848	2123	2327	2542	9999
	D	1055	1057	1060	1062	1065	1323	1892	2147	2330	2520	9999
	H	1070	1077	1082	1084	1086	1136	1124	1132	1136	1139	1142
13	V	1033	1033	1031	1031	1030	1344	1896	2160	2350	2556	9999
	D	997	1000	1004	1006	1006	1306	1821	2062	2240	2419	9999
	H	1001	1006	1012	1022	1035	1045	1052	1060	1064	1070	1074
14	V	1022	1020	1019	1019	1019	1024	1024	1024	1026	1026	1026
	D	961	962	968	974	988	996	1000	1005	1010	1012	1012
	H	990	991	992	993	994	985	971	965	962	959	953
15	V	1002	1000	1000	999	999	996	998	996	995	996	996
	D	988	991	994	995	997	991	989	988	988	987	986
	H	1005	1005	1007	1008	1009	996	985	981	978	978	973
16	V	999	998	997	998	998	1085	1614	1871	2065	2266	2510
	D	1042	1045	1047	1050	1050	1357	1871	2117	2294	2472	9999
	H	999	1002	1004	1007	1008	1093	1208	1267	1306	1341	1386
17	V	1065	1065	1064	1063	1063	1338	1828	2068	2242	2430	9999
	D	1043	1046	1049	1051	1055	1327	1761	1981	2135	2297	9999
	H	1005	1008	1010	1018	1021	1042	1052	1061	1069	1071	1080
18	V	1012	1010	1009	1009	1009	1011	1011	1012	1012	1011	1011
	D	927	929	933	937	948	968	973	982	990	996	1000

Table 4.2-PSN2 Concrete Demec Readings for Beam PSN2-WD

STATION	APPLIED SHEAR (KN)	0.0	30.0	60.0	75.0	90.0	97.5	105.0	112.5	120.0	135.0	150.0	165.0	180.0	195.0	202.5
		SIDE A														
		Demec Readings														
2		891	897	898	906	903	903	906	911	915	939	958	979	998	1014	1023
3		875	881	889	892	897	897	899	918	928	966	983	1003	1024	1049	1064
4		930	943	950	960	968	980	997	1029	1047	1070	1087	1111	1130	1152	1161
5		950	958	969	987	999	1010	1025	1048	1054	1088	1108	1126	1160	1187	1199
6		880	891	914	933	940	957	970	981	985	1013	1035	1050	1071	1091	1100
7		902	899	898	900	901	898	897	897	892	888	890	883	880	879	877
8		959	961	961	959	961	960	961	953	948	949	946	942	935	932	927
9		925	925	923	927	926	928	925	938	954	1003	1047	1093	1135	1185	1213
9A		916	912	917	914	919	939	955	979	980	985	979	977	976	980	977
10		828	840	857	872	897	910	919	937	947	965	990	1010	1034	1055	1064
11	H	903	899	902	903	905	909	905	906	905	912	940	975	1000	1029	1038
	V	901	903	902	900	905	903	901	903	921	1052	1131	1323	1314	1435	1513
	D	901	907	908	909	910	913	913	925	962	1128	1220	1334	1438	1566	1671
12	H	914	923	924	927	929	936	931	961	993	1063	1091	1131	1164	1208	1243
	V	934	936	936	934	934	934	938	993	1055	1215	1312	1427	1549	1715	1823
	D	924	929	930	936	936	945	966	1067	1146	1341	1470	1619	1767	1960	2083
13	H	921	930	935	940	945	952	983	1011	1018	1031	1038	1049	1060	1072	1074
	V	910	908	905	906	905	914	947	1055	1110	1169	1145	1117	1115	1120	1123
	D	920	927	929	937	942	960	1012	1145	1217	1249	1239	1237	1251	1266	1275
14	H	918	924	935	943	950	990	997	1000	1010	1024	1034	1049	1061	1072	1084
	V	918	916	917	916	919	951	976	980	984	988	992	997	1004	1015	1020
	D	919	926	934	941	953	1008	1023	1029	1034	1050	1055	1068	1087	1101	1109
15	H	911	915	917	916	919	919	921	915	909	902	895	891	886	878	872
	V	961	961	961	962	961	961	962	962	960	1016	1098	1188	1269	1367	1417
	D	919	921	924	926	929	931	935	933	928	927	966	1020	1060	1104	1126
16	H	960	963	965	968	970	967	963	955	953	990	1066	1166	1240	1320	1373
	V	898	899	897	898	897	899	897	961	998	1153	1261	1388	1509	1673	1781
	D	926	930	931	936	938	936	933	954	1006	1179	1311	1468	1612	1794	1910
17	H	921	923	928	931	934	929	943	1011	1045	1094	1077	1052	1046	1035	1033
	V	927	927	923	926	926	926	957	1053	1099	1205	1294	1394	1495	1626	1715
	D	932	936	942	944	943	942	975	1096	1156	1294	1410	1537	1662	1813	1915
18	H	941	946	953	956	965	999	1018	1020	1016	1023	1024	1032	1040	1049	1052
	V	907	907	906	904	902	927	943	978	988	999	1004	1006	1012	1017	1021
	D	918	923	924	923	919	965	996	1018	1018	1027	1028	1032	1039	1046	1051

Table 4.2-PSN2 Concrete Demec Readings for Beam PSN2-WD

STATION	APPLIED SHEAR(KN)	0.0	30.0	60.0	75.0	90.0	97.5	105.0	112.5	120.0	135.0	150.0	165.0	180.0	195.0	202.5
		SIDE B														
		Demec Readings														
2		1019	1021	1023	1026	1025	1026	1026	1029	1030	1039	1047	1057	1069	1079	1085
3		1018	1021	1025	1028	1030	1032	1033	1057	1067	1098	1116	1139	1162	1193	1215
4		1015	1021	1028	1031	1038	1046	1062	1080	1089	1107	1120	1132	1146	1179	1172
5		1059	1066	1073	1078	1086	1101	1139	1150	1178	1184	1208	1221	1242	1263	1271
6		1031	1045	1058	1077	1100	1112	1125	1135	1149	1168	1185	1237	1226	1241	1252
7		1012	1010	1008	1010	1008	1007	1005	1004	1004	1000	997	995	987	982	979
8		1063	1062	1060	1060	1059	1060	1057	1053	1054	1051	1048	1046	1078	1121	1142
9		1007	1006	1004	1005	1006	1006	1014	1040	1050	1086	1115	1147	1157	1148	1150
9A		1022	1021	1021	1021	1024	1031	1048	1052	1053	1058	1060	1060	1061	1063	1064
	H	1022	1024	1026	1025	1027	1028	1028	1021	1017	1049	1080	1119	1171	1220	1252
11	V	1022	1023	1022	1021	1021	1021	1022	1035	1052	1151	1109	1302	1441	1616	1730
	D	1023	1026	1026	1029	1030	1032	1033	1066	1095	1217	1278	1376	1522	1692	1803
	H	1022	1025	1028	1031	1033	1035	1052	1104	1124	1156	1167	1179	1184	1183	1190
12	V	1017	1017	1017	1015	1014	1014	1025	1108	1143	1269	1345	1467	1652	1861	2003
	D	1023	1027	1030	1031	1032	1033	1072	1178	1217	1365	1453	1497	1495	1490	1507
	H	1023	1029	1033	1036	1036	1047	1070	1071	1073	1083	1090	1097	1106	1115	1119
13	V	1033	1033	1031	1030	1030	1037	1100	1193	1230	1260	1257	1253	1254	1269	1279
	D	1023	1027	1029	1032	1032	1047	1137	1229	1260	1284	1297	1307	1320	1344	1359
	H	1010	1023	1030	1036	1040	1058	1064	1070	1076	1089	1097	1109	1119	1128	1137
14	V	1028	1026	1024	1024	1024	1041	1048	1049	1051	1057	1063	1070	1076	1083	1088
	D	1023	1030	1033	1037	1051	1078	1085	1090	1095	1110	1125	1138	1153	1169	1179
	H	1011	1012	1013	1016	1014	1014	1011	1005	1003	998	994	983	974	967	963
15	V	1022	1023	1023	1023	1022	1026	1027	1024	1022	1107	1182	1274	1431	1632	1754
	D	1022	1022	1025	1026	1027	1030	1030	1024	1024	1063	1112	1207	1383	1590	1709
	H	1012	1013	1018	1017	1017	1016	1011	1005	1005	1045	1098	1163	1234	1289	1325
16	V	1000	1000	1000	998	998	1000	1036	1123	1178	1287	1364	1471	1647	1848	1986
	D	1015	1020	1023	1023	1026	1025	1048	1153	1194	1332	1421	1542	1713	1904	2033
	H	1021	1024	1025	1027	1028	1027	1067	1114	1136	1156	1146	1137	1128	1128	1129
17	V	1030	1030	1029	1027	1027	1034	1095	1171	1207	1302	1369	1458	1522	1549	1588
	D	1020	1024	1026	1029	1031	1035	1109	1208	1237	1357	1443	1556	1575	1570	1595
	H	990	992	997	999	1003	1022	1031	1034	1034	1042	1050	1057	1063	1068	1074
18	V	1015	1015	1015	1012	1009	1022	1042	1046	1049	1054	1059	1065	1071	1078	1082
	D	1026	1030	1033	1036	1041	1062	1087	1090	1094	1104	1114	1123	1135	1148	1156

Table 4.2-PSN3 Concrete Demec Readings for Beam PSN3-D2

SIDE A

STATION	APPLIED SHEAR(KN)	0.0	30.0	60.0	75.0	90.0	97.5	105.0	112.5	120.0	135.0	150.0	165.0	180.0	195.0	210.0
	Demec Readings															
2		875	881	884	887	892	889	894	896	905	917	925	936	953	968	1000
3		874	879	889	896	898	900	902	918	953	980	1002	1031	1054	1089	1114
4		872	883	891	897	902	905	933	941	973	982	1000	1014	1031	1054	1078
5		860	873	900	917	936	952	995	1007	1031	1059	1085	1112	1134	1159	1180
6		909	921	946	955	985	1004	1018	1033	1050	1076	1103	1129	1155	1185	1213
7		870	871	870	872	876	874	872	864	863	858	855	852	850	845	840
8		862	861	862	862	857	860	854	855	850	845	842	837	831	825	817
9		883	881	883	884	890	890	921	938	993	1025	1058	1096	1143	1195	1252
9A		860	861	860	863	867	874	874	871	875	878	885	890	996	903	907
10		871	891	912	927	960	985	997	1005	1028	1047	1075	1101	1120	1144	1176
	H	867	873	876	878	879	885	886	882	889	898	907	902	1005	1082	1160
11	V	868	868	864	865	864	864	866	866	923	995	1058	1145	1259	1408	1594
	D	870	872	875	879	883	884	887	891	988	1074	1149	1265	1413	1598	1813
	H	869	876	882	887	890	891	890	894	961	999	1034	1055	1060	1061	1068
12	V	860	862	860	861	860	858	869	899	1063	1160	1259	1366	1568	1783	2026
	D	879	884	886	890	895	902	946	995	1181	1299	1416	1570	1759	1992	2250
	H	892	894	905	905	921	934	988	1015	1026	1042	1056	1072	1086	1102	1120
13	V	875	874	872	871	872	875	945	989	1016	1025	1049	1085	1121	1161	1202
	D	879	884	891	897	904	919	1028	1089	1112	1133	1169	1211	1252	1295	1338
	H	875	881	892	903	906	911	921	924	928	934	943	951	957	967	982
14	V	863	861	859	857	863	863	864	864	863	866	868	872	874	880	885
	D	868	875	879	879	888	895	898	900	904	910	920	927	935	949	961
	H	874	876	879	881	885	883	882	880	870	863	860	859	846	836	833
15	V	860	860	860	858	859	860	861	861	930	984	1030	1123	1256	1432	1616
	D	865	868	877	878	880	881	882	883	876	885	895	990	1146	1358	1544
	H	862	866	869	871	871	874	867	865	936	988	1029	1080	1137	1210	1288
16	V	862	863	863	863	862	863	856	859	1021	1114	1206	1334	1494	1700	1923
	D	872	878	885	886	891	891	890	890	1059	1162	1262	1390	1554	1753	1975
	H	868	871	875	882	888	888	950	977	980	982	997	1005	1014	1025	1038
17	V	881	880	880	880	880	888	972	1016	1135	1215	1310	1431	1585	1763	1967
	D	875	883	890	892	900	909	1016	1065	1219	1323	1433	1575	1743	1945	2160
	H	867	874	882	888	900	906	903	904	908	913	913	917	920	924	928
18	V	880	881	877	877	873	873	876	877	878	876	875	875	876	879	881
	D	885	891	895	901	915	926	925	926	925	931	935	939	944	950	955

Table 4.2-PSN3 Concrete Demec Readings for Beam PSN3-D2

STATION	APPLIED SHEAR (KN)	0.0	30.0	60.0	75.0	90.0	97.5	105.0	112.5	120.0	135.0	150.0	165.0	180.0	195.0	210.0
		SIDE B														
		Demec Readings														
2		1015	1016	1020	1023	1024	1026	1028	1027	1028	1032	1038	1059	1081	1102	1125
3		1020	1023	1024	1026	1035	1038	1042	1045	1056	1110	1124	1130	1153	1169	1183
4		1021	1022	1025	1030	1035	1047	1050	1065	1070	1092	1090	1104	1121	1133	1136
5		1015	1023	1040	1050	1063	1082	1088	1125	1144	1148	1185	1197	1220	1249	1275
6		1016	1027	1039	1049	1057	1080	1090	1115	1141	1048	1169	1188	1215	1222	1259
7		1017	1015	1012	1013	1015	1012	1017	1013	1015	1010	1003	1004	1000	997	985
8		1023	1021	1021	1013	1015	1019	1021	1020	1020	1050	1066	1088	1114	1140	1173
9		1014	1011	1008	1009	1012	1010	1015	1036	1052	1065	1071	1079	1082	1082	1085
9A		1021	1020	1020	1020	1021	1027	1032	1045	1046	1043	1052	1057	1057	1063	1066
	H	1021	1023	1022	1025	1022	1020	1018	1023	1020	1035	1053	1108	1152	1208	1251
11	V	1014	1013	1010	1011	1011	1009	1011	1011	1015	1100	1152	1233	1345	1494	1677
	D	1027	1029	1032	1033	1030	1036	1035	1039	1050	1171	1200	1338	1470	1638	1855
	H	1021	1021	1026	1026	1027	1025	1034	1032	1040	1090	1100	1098	1095	1093	1095
12	V	1017	1022	1020	1017	1017	1018	1018	1022	1045	1201	1281	1393	1551	1751	2000
	D	1036	1038	1041	1043	1043	1045	1047	1060	1095	1269	1358	1479	1640	1832	2067
	H	1018	1021	1023	1026	1038	1035	1042	1083	1113	1124	1139	1152	1178	1187	1210
13	V	1021	1019	1019	1019	1020	1020	1020	1054	1099	1122	1134	1145	1163	1178	1198
	D	1031	1042	1040	1045	1045	1050	1055	1111	1171	1190	1210	1236	1262	1287	1316
	H	1021	1022	1029	1040	1043	1065	1088	1090	1096	1103	1125	1132	1141	1155	1172
14	V	1037	1040	1035	1038	1038	1040	1045	1046	1045	1045	1046	1046	1045	1045	1047
	D	1044	1050	1053	1053	1052	1072	1082	1160	1180	1197	1218	1245	1277	1306	1336
	H	1012	1011	1013	1012	1007	1011	1015	1010	1012	1001	997	995	990	980	977
15	V	1025	1029	1027	1027	1028	1030	1030	1030	1033	1062	1119	1203	1328	1465	1618
	D	1002	1002	1005	1008	1010	1010	1010	1012	1008	1006	1036	1154	1293	1448	1619
	H	1022	1020	1020	1025	1028	1028	1026	1022	1022	1086	1117	1157	1200	1242	1295
16	V	1044	1045	1044	1043	1044	1046	1046	1045	1042	1173	1208	1353	1496	1688	1906
	D	1039	1042	1044	1045	1046	1048	1048	1048	1046	1193	1271	1373	1528	1686	1889
	H	1010	1009	1010	1011	1020	1024	1023	1063	1093	1106	1114	1126	1130	1145	1157
17	V	1020	1022	1017	1020	1016	1018	1018	1068	1110	1142	1165	1193	1221	1246	1274
	D	1014	1016	1019	1022	1021	1022	1025	1088	1142	1274	1359	1475	1607	1782	1984
	H	1015	1020	1021	1019	1025	1047	1045	1052	1050	1052	1054	1060	1057	1059	1070
18	V	1038	1035	1035	1040	1035	1040	1043	1046	1046	1048	1044	1048	1052	1055	1057
	D	1013	1014	1017	1021	1022	1035	1044	1047	1047	1048	1051	1057	1058	1061	1064

Table 4.2-PSN4 Concrete Demec Readings for Beam PSN4-WDH

STATION	APPLIED SHEAR (KN)	0.0	30.0	60.0	75.0	90.0	97.5	105.0	112.5	120.0	135.0	150.0	165.0	180.0	195.0	202.5
		SIDE A														
		Demec Readings														
2		847	850	853	861	859	862	865	865	878	886	896	909	922	940	952
3		869	872	882	890	890	890	903	918	957	971	992	1011	1038	1070	1086
4		859	867	880	885	885	890	892	932	946	962	986	1012	1027	1052	1069
5		849	859	870	877	888	898	932	970	984	1008	1026	1042	1061	1085	1096
6		852	855	867	887	897	909	923	923	934	960	879	1006	1028	1047	1065
7		863	865	860	861	865	866	862	860	857	853	847	847	840	833	831
8		863	860	858	861	862	863	864	860	853	852	846	836	833	825	817
9		916	914	915	914	916	918	945	975	1011	1060	1095	1125	1166	1221	1259
9A		863	864	866	864	866	872	883	880	875	881	887	897	907	914	917
10		960	981	1003	1008	1014	1024	1028	1044	1052	1074	1114	1146	1169	1197	1217
	H	854	859	862	866	868	869	869	871	920	977	1030	1086	1150	1243	1302
11	V	846	846	846	844	844	845	847	850	961	1068	1171	1293	1413	1619	1759
	D	874	880	885	886	887	890	891	898	1039	1158	1272	1407	1545	1766	1914
	H	863	868	873	879	883	889	881	921	941	945	956	959	964	962	963
12	V	892	891	891	890	890	890	891	962	1126	1264	1401	1556	1721	1981	2149
	D	877	880	886	890	892	894	896	986	1162	1312	1459	1627	1797	2066	2242
	H	874	878	890	894	898	900	915	960	957	961	972	984	991	1005	1012
13	V	873	870	871	869	870	869	884	1018	1162	1207	1214	1229	1253	1292	1313
	D	879	883	892	891	904	918	958	1128	1289	1292	1297	1313	1342	1369	1381
	H	870	883	893	908	915	935	957	954	958	964	977	982	990	1001	1004
14	V	896	895	893	895	893	895	900	898	896	897	898	902	909	918	922
	D	887	895	902	910	928	940	967	963	962	965	974	991	1008	1031	1046
	H	894	896	900	905	904	906	906	896	888	880	876	870	863	853	850
15	V	865	865	869	867	866	867	870	869	1022	1146	1269	1408	1552	1779	1934
	D	869	871	877	877	883	884	886	979	1017	1172	1300	1455	1618	1860	2022
	H	886	890	894	897	900	900	893	888	886	937	1015	1186	1253	1345	1310
16	V	875	872	874	873	873	871	876	957	1112	1252	1387	1536	1694	1940	2101
	D	867	865	872	875	875	875	878	923	1096	1250	1396	1549	1710	1951	2112
	H	871	876	881	880	887	887	922	992	1059	1066	1051	1038	1033	1022	1015
17	V	889	889	889	889	889	886	917	1041	1155	1267	1383	1510	1643	1847	1983
	D	882	886	895	895	898	905	963	1095	1231	1365	1503	1647	1795	2019	2161
	H	884	889	898	903	909	917	916	914	915	921	932	960	976	995	1003
18	V	906	904	905	906	902	906	918	918	918	918	915	914	916	907	907
	D	886	890	895	900	903	912	932	923	920	920	945	981	1003	1031	1046

Table 4.2-PSN4 Concrete Demec Readings for Beam PSN4-WDH

SIDE B

STATION	APPLIED SHEAR (KN)	0.0	30.0	60.0	75.0	90.0	97.5	105.0	112.5	120.0	135.0	150.0	165.0	180.0	195.0	202.5
		Demec Readings														
2		1018	1017	1022	1026	1026	1027	1027	1028	1030	1060	1074	1078	1078	1075	1072
3		1015	1020	1022	1030	1035	1033	1037	1035	1042	1077	1087	1101	1136	1168	1193
4		1025	1028	1038	1040	1051	1052	1062	1084	1103	1120	1129	1143	1151	1169	1183
5		1033	1039	1050	1055	1064	1067	1075	1093	1100	1121	1144	1157	1173	1201	1207
6		996	1005	1012	1027	1042	1045	1065	1076	1090	1101	1122	1150	1158	1182	1196
7		1023	1023	1023	1023	1025	1026	1028	1028	1028	1022	1021	1015	1014	1009	1011
8		1018	1016	1013	1015	1014	1012	1013	1016	1012	1005	1003	998	994	991	984
9		1024	1022	1024	1022	1023	1022	1025	1044	1062	1120	1149	1187	1218	1258	1281
9A		1025	1028	1026	1022	1027	1031	1031	1031	1031	1030	1029	1032	1035	1043	1044
	H	1010	1010	1010	1027	1025	1022	1026	1030	1030	1030	1030	1031	1056	1076	1082
11	V	1013	1013	1012	1014	1014	1010	1013	1011	1013	1166	1245	1338	1419	1555	1537
	D	1013	1014	1018	1020	1021	1020	1020	1025	1028	1201	1288	1386	1479	1633	1730
	H	1023	1023	1028	1032	1035	1038	1029	1035	1042	1132	1170	1196	1204	1259	1285
12	V	1020	1019	1020	1018	1017	1015	1017	1018	1052	1272	1377	1501	1640	1842	1973
	D	1017	1021	1021	1020	1023	1027	1029	1032	1082	1313	1421	1554	1690	1883	2009
	H	1028	1030	1033	1042	1047	1044	1041	1080	1117	1131	1137	1151	1156	1170	1179
13	V	1030	1026	1027	1027	1025	1027	1025	1093	1136	1139	1169	1199	1199	1199	1202
	D	1048	1052	1056	1059	1060	1066	1069	1120	1205	1431	1560	1696	1837	2035	2164
	H	1030	1033	1036	1052	1063	1070	1089	1091	1096	1102	1111	1127	1135	1140	1142
14	V	1016	1020	1015	1018	1018	1016	1010	1007	1007	1011	1008	1008	1010	1010	1011
	D	1020	1027	1030	1039	1050	1061	1084	1145	1162	1190	1196	1207	1214	1228	1235
	H	1015	1010	1010	1018	1014	1018	1017	1016	1013	1005	1000	993	987	984	979
15	V	1021	1025	1024	1027	1028	1026	1025	1025	1024	1028	1030	1078	1132	1197	1240
	D	1011	1014	1016	1018	1021	1022	1022	1023	1021	1017	1016	1017	1021	1034	1049
	H	1014	1012	1007	1018	1021	1021	1017	1015	1012	1046	1111	1162	1222	1282	1323
16	V	1022	1021	1020	1020	1019	1022	1022	1015	1012	1302	1319	1442	1578	1767	1892
	D	1023	1028	1030	1032	1034	1037	1039	1032	1036	1046	1312	1441	1579	1760	1882
	H	1024	1027	1031	1033	1035	1040	1045	1085	1124	1138	1157	1158	1160	1155	1152
17	V	1027	1029	1027	1030	1029	1029	1025	1065	1127	1277	1368	1467	1574	1724	1823
	D	1037	1039	1043	1044	1046	1049	1075	1132	1205	1388	1503	1614	1740	1898	2009
	H	1020	1028	1032	1035	1045	1040	1033	1032	1028	1023	1030	1033	1039	1032	1030
18	V	1024	1026	1022	1025	1028	1023	1028	1017	1020	1019	1019	1022	1023	1023	1016
	D	1015	1019	1021	1024	1027	1029	1040	1080	1128	1212	1216	1206	1202	1201	1207

Table 4.2-PSN5 Concrete Demec Readings for Beam PSN5-S6M

STATION	APPLIED SHEAR (KN)	0.0	30.0	60.0	75.0	90.0	97.5	105.0	120.0	135.0	150.0	165.0	180.0	195.0	210.0
							SIDE A Demec Readings								
2		868	870	874	881	880	883	883	886	906	918	948	973	999	1023
3		875	881	885	890	892	893	895	936	973	982	1000	1016	1040	1060
4		869	879	890	896	900	902	909	952	977	1006	1043	1054	1075	1101
5		882	891	905	924	942	952	971	1020	1059	1073	1107	1120	1144	1178
6		871	888	906	928	946	960	990	1015	1050	1075	1097	1120	1238	1172
7		874	871	872	872	869	872.	972	866	863	853	855	852	846	844
8		884	884	884	884	880	880	880	876	873	863	861	854	850	847
9		882	879	880	882	881	882	885	917	962	891	1035	1077	1129	1182
9A		872	872	870	868	868	872	890	910	923	927	937	942	953	961
10		869	888	903	912	937	951	963	980	1010	1030	1056	1076	1100	1126
	H	873	875	873	880	882	885	882	876	890	883	851	834	802	771
11	V	856	857	855	853	856	855	855	858	958	1038	1177	1289	1403	1522
	D	944	947	949	951	953	854	954	975	1116	1215	1394	1546	1724	1923
	H	874	875	883	890	890	891	899	876	941	1091	1074	1143	1267	1434
12	V	884	882	879	881	880	879	879	997	1078	1309	1516	1725	1978	2237
	D	879	885	889	891	895	898	899	1064	1284	1441	1588	1927	2217	2496
	H	889	895	901	911	916	920	922	1011	1025	1046	1081	1116	1132	1086
13	V	875	874	875	875	875	874	876	1059	1247	1385	1596	1791	2020	2263
	D	883	889	895	901	906	910	924	1150	1372	1530	1772	2000	2267	2599
	H	871	879	891	898	901	906	943	983	1004	1020	1045	1060	1080	1101
14	V	877	875	873	872	872	874	891	933	945	957	878	994	1015	1032
	D	873	874	881	886	889	896	947	997	1022	1046	1078	1103	1130	1158
	H	876	876	882	881	882	882	884	877	869	862	855	842	838	826
15	V	846	848	847	847	846	846	846	847	908	956	954	953	950	948
	D	866	870	875	877	880	882	881	878	877	884	885	880	876	872
	H	880	881	886	889	890	890	890	872	871	862	860	852	849	840
16	V	859	857	857	858	856	857	859	850	1007	1093	1223	1339	1499	1720
	D	884	890	892	895	895	898	901	1081	1296	1444	1679	1899	2158	944
	H	881	883	890	895	898	903	897	968	1048	1100	1181	1259	1353	1459
17	V	871	872	870	870	872	869	870	1005	1158	1270	1437	1601	1780	1978
	D	889	896	899	903	903	905	907	1095	1273	1397	1584	1755	1960	2182
	H	876	881	887	891	898	899	930	960	975	993	1010	1023	1036	1048
18	V	870	869	866	864	863	860	879	925	943	960	983	1002	1023	1043
	D	883	887	891	895	898	896	933	985	1009	1031	1059	1082	1108	1132

Table 4.2-PSN5 Concrete Demec Readings for Beam PSN5-S6M

STATION	APPLIED SHEAR (KN)	0.0	30.0	60.0	75.0	90.0	97.5	105.0	120.0	135.0	150.0	165.0	180.0	195.0	210.0
		SIDE B													
		Demec Readings													
2		1014	1020	1021	1021	1024	1024	1024	1025	1029	1039	1048	1066	1073	1095
3		1021	1026	1030	1030	1034	1034	1035	1038	1072	1101	1116	1137	1156	1176
4		1045	1051	1059	1065	1071	1079	1086	1111	1063	1181	1201	1225	1218	1275
5		1019	1021	1034	1040	1045	1051	1059	1089	1110	1131	1147	1166	1185	1205
6		1031	1046	1060	1071	1089	1102	1128	1038	1067	1183	1206	1226	1246	1271
7		1011	1012	1011	1011	1011	1010	1010	1005	1002	999	996	992	988	979
8		1003	1003	1002	1003	1002	1000	1001	999	992	987	981	966	973	966
9		1018	1019	1018	1019	1018	1019	1020	1017	1047	1086	1125	1165	1211	1260
9A		1016	1016	1016	1017	1017	1020	1024	1049	1078	1071	1170	1068	1064	1062
	H	1011	1012	1015	1014	1012	1017	1018	1018	1002	1100	998	1062	987	973
11	V	1008	1010	1012	1010	1010	1011	1011	1010	1066	1186	1289	1426	1061	1700
	D	1021	1018	1022	1018	1023	1024	1025	1023	1121	1255	1380	1521	1674	1835
	H	1016	1017	1022	1024	1027	1028	1028	1025	1112	1172	1225	1282	1359	1420
12	V	1012	1010	1010	1010	1011	1011	1010	1018	1200	1344	1493	1650	1830	2025
	D	1019	1020	1023	1024	1025	1028	1022	1055	1275	1433	1596	1766	1964	2166
	H	1067	1071	1076	1081	1085	1086	1091	1026	1156	1163	1176	1272	1197	1210
13	V	1017	1015	1015	1015	1015	1016	1019	1155	1173	1176	1216	1190	1201	1115
	D	1020	1020	1025	1028	1032	1037	1043	1121	1278	1451	1614	1788	1948	2102
	H	1021	1025	1033	1037	1046	1048	1055	1075	1081	1088	1094	1102	1109	1118
14	V	1023	1020	1016	1016	1017	1019	1024	1081	1111	1117	1123	1128	1133	1140
	D	1018	1019	1023	1026	1033	1039	1052	1140	1153	1171	1173	1183	1193	1205
	H	1013	1017	1018	1019	1020	1013	1021	1013	1008	998	995	977	981	974
15	V	1013	1013	1012	1012	1011	1012	1011	1013	1015	997	983	955	945	945
	D	1023	1025	1029	1031	1032	1032	1034	1033	1028	1047	1074	1151	1404	1597
	H	1011	1014	1015	1018	1018	1020	1018	1014	1032	1106	1163	1227	1308	1373
16	V	1012	1012	1011	1011	1011	1011	1012	1011	1070	1207	1444	1694	1758	1920
	D	1014	1015	1017	1020	1021	1020	1021	1020	1165	1421	1578	1747	1933	2133
	H	1022	1022	1026	1027	1030	1032	1033	1024	1091	1079	1079	1071	1067	1165
17	V	1010	1017	1019	1016	1016	1017	1017	1057	1117	1228	1444	1069	1704	1855
	D	1019	1020	1024	1027	1030	1031	1034	1122	1320	1453	1591	1733	1891	2065
	H	1013	1019	1024	1027	1031	1038	1051	1103	1106	1107	1109	1111	1112	1115
18	V	1031	1028	1027	1026	1026	1023	1022	1050	1100	1109	1115	1217	1120	1124
	D	1021	1022	1025	1027	1030	1039	1053	1112	1153	1157	1163	1165	1170	1176

Table 4.2-PSN6 Concrete Demec Readings for Beam PSN6-WS

STATION	APPLIED SHEAR (KN)	0.0	30.0	60.0	75.0	90.0	97.5	105.0	112.5	120.0	135.0	150.0	165.0	180.0	195.0	210.0
		SIDE A — Demec Readings														
2		868	872	878	880	882	884	884	887	893	905	920	942	966	989	1013
3		864	870	877	881	889	891	893	895	916	949	955	973	993	1013	1033
4		850	866	872	881	894	907	916	930	970	992	1014	1040	1066	1084	1113
5		874	877	898	905	915	925	941	961	975	993	1014	1030	1048	1061	1074
6		859	871	895	914	930	949	961	973	988	1008	1027	1051	1067	1088	1112
7		880	877	879	879	878	879	880	881	878	879	870	867	866	863	858
8		870	871	867	868	869	866	867	869	866	853	854	849	845	844	839
9		880	876	882	879	879	880	882	883	885	914	938	971	1011	1044	1078
9A		877	875	877	878	875	879	887	901	933	948	951	957	964	967	975
10		870	881	906	925	944	958	970	980	991	1020	1041	1061	1080	1105	1121
	H	870	877	878	877	879	883	880	882	872	872	863	856	841	830	814
11	V	871	873	871	871	870	872	871	873	879	912	979	1031	1088	1126	1167
	D	874	881	884	885	887	891	895	898	922	972	1057	1124	1212	1285	1366
	H	864	869	874	873	883	881	883	880	875	865	863	913	1020	1123	1231
12	V	889	888	887	886	887	887	888	893	864	1067	1164	1264	1390	1506	1645
	D	865	869	874	877	881	885	889	912	1026	1168	1309	1458	1642	1833	2035
	H	872	874	884	888	893	896	895	890	943	1017	1084	1098	1085	1168	1055
13	V	879	873	871	871	872	873	877	905	1012	1136	1255	1371	1520	1674	1835
	D	867	871	879	880	885	887	898	951	1085	1242	1387	1536	1732	1920	2123
	H	872	881	898	903	906	905	924	967	992	1009	1025	1043	1060	1076	1093
14	V	879	877	875	875	876	879	902	932	989	1005	1015	1027	1045	1064	1086
	D	867	876	882	887	900	906	944	994	1057	1077	1102	1127	1161	1195	1229
	H	893	897	898	898	900	900	899	900	895	890	890	884	870	868	859
15	V	875	874	874	875	873	875	876	876	876	876	875	874	874	875	873
	D	860	868	873	873	879	881	883	882	886	886	884	883	880	884	880
	H	869	874	875	878	878	883	882	879	871	864	860	857	849	845	835
16	V	883	880	882	879	879	881	883	881	879	876	884	1002	1137	1265	1402
	D	873	876	881	883	889	889	890	886	882	884	881	890	1023	1185	1362
	H	870	871	878	876	878	877	879	880	900	957	1015	1071	1139	1205	1277
17	V	850	850	850	849	849	850	848	843	898	1011	1108	1201	1319	1433	1560
	D	868	873	879	879	883	884	880	894	1017	1157	1282	1407	1562	1713	1872
	H	912	920	922	930	945	958	886	917	1061	1069	1079	1093	1105	1113	1127
18	V	882	881	878	877	874	874	880	898	935	969	979	988	1001	1013	1031
	D	860	873	878	884	902	917	942	978	1046	1072	1087	1104	1124	1147	1174

Table 4.2-PSN6 Concrete Demec Readings for Beam PSN6-WS

SIDE B — Demec Readings

STATION		APPLIED SHEAR (KN) 0.0	30.0	60.0	75.0	90.0	97.5	105.0	112.5	120.0	135.0	150.0	165.0	180.0	195.0	210.0
2		1014	1019	1019	1020	1022	1023	1024	1025	1027						
3		1011	1021	1021	1024	1028	1030	1033	1035	1051	1034	1048	1060	1069	1076	1084
4		998	1012	1012	1019	1024	1028	1034	1043	1077	1093	1111	1125	1141	1160	1183
5		1022	1041	1041	1045	1052	1055	1067	1082	1101	1080	1120	1140	1149	1182	1202
6		1018	1043	1043	1054	1065	1066	1084	1090	1101	1116	1131	1145	1159	1174	1189
7		1015	1013	1013	1013	1012	1013	1014	1013	1011	1116	1131	1146	1162	1178	1194
8		1011	1009	1009	1008	1007	1009	1010	1008	1004	1006	1003	1000	998	993	989
9		1014	1011	1011	1012	1011	1012	1012	1017	1054	999	996	992	986	981	966
9A		1015	1012	1012	1014	1015	1019	1020	1023	1018	1093	1125	1157	1194	1234	1277
11	H	1015	1019	1019	1019	1018	1021	1022	1023	1020	1019	1018	1016	1017	1013	1015
	V	1015	1013	1013	1014	1013	1013	1012	1014	1015	1018	1017	1032	1049	1065	1086
	D	1013	1018	1018	1020	1021	1023	1024	1024	1039	1106	1220	1295	1379	1475	1631
12	H	1010	1016	1016	1021	1022	1025	1027	1027	1038	1161	1284	1372	1473	1585	1745
	V	1015	1013	1013	1013	1012	1012	1006	1015	1064	1126	1174	1207	1241	1276	1311
	D	992	1000	1000	1001	1003	1006	1008	1010	1097	1211	1345	1448	1564	1700	1885
13	H	1004	1016	1016	1021	1023	1026	1027	1028	1076	1266	1411	1531	1659	1805	1990
	V	1026	1025	1025	1025	1024	1026	1028	1035	1141	1075	1080	1086	1093	1100	1109
	D	1011	1022	1022	1025	1029	1032	1037	1058	1192	1291	1370	1339	1306	1297	1278
14	H	1019	1018	1018	1022	1025	1035	1047	1074	1073	1373	1428	1403	1391	1398	1410
	V	1022	1019	1019	1017	1017	1019	1023	1041	1039	1079	1090	1098	1108	1119	1131
	D	1022	1031	1031	1035	1039	1046	1061	1093	1105	1037	1035	1035	1036	1037	1037
15	H	981	985	985	984	985	987	987	988	982	1106	1111	1114	1126	1131	1143
	V	994	994	994	993	994	994	995	995	995	973	967	961	955	949	944
	D	1015	1021	1021	1023	1024	1025	1025	1028	1025	988	976	996	1021	1057	1083
16	H	1003	1009	1009	1008	1009	1010	1010	1011	1103	1057	1210	1326	1454	1586	1761
	V	1008	1006	1006	1006	1008	1006	1007	1008	1031	1095	1090	1087	1164	1228	1298
	D	1020	1028	1028	1028	1031	1033	1035	1034	1038	1193	1323	1425	1444	1680	1851
17	H	1014	1022	1022	1023	1025	1025	1025	1023	1089	1213	1357	1477	1510	1752	1929
	V	1015	1014	1014	1012	1013	1014	1013	1015	1108	1167	1204	1180	1158	1152	1146
	D	1010	1027	1027	1029	1032	1035	1042	1069	1190	1235	1333	1419	1517	1629	1765
18	H	1016	1025	1025	1028	1036	1043	1053	1075	1064	1340	1459	1570	1690	1819	1972
	V	1015	1018	1018	1013	1012	1016	1020	1023	1020	1061	1062	1058	1064	1067	1069
	D	1029	1021	1021	1025	1034	1043	1050	1069	1155	1020	1121	1021	1123	1123	1025
											1253	1313	1319	1315	1306	1306

Table 4.3-PSN1 Readings of Steel Strains and Deflections for Beam PSN1-0

	LOAD # 1 kn	STROK # 1 mm	LVDT # 1 mm	LVDT # 2 mm	LVDT # 3 mm	LVDT # 4 mm	LVDT # 5 mm	LVDT # 6 mm	LVDT # 7 mm	STRAI # 1 uE L1	STRAI # 2 uE L2
1	0.02	0.00	0.00	0.00	-0.00	-0.00	-0.00	0.00	0.00	-0	0
2	-29.54	-0.79	0.27	0.25	0.23	-0.05	0.12	-0.02	0.12	49	47
3	-59.00	-1.43	0.53	0.52	0.46	0.01	0.22	-0.06	0.22	101	83
4	-90.28	-2.08	0.83	0.74	0.73	0.14	0.29	-0.24	0.30	166	141
5	-118.52	-2.64	1.14	1.05	1.01	0.17	0.36	-0.27	0.35	245	199
6	-130.28	-2.90	1.30	1.21	1.15	0.19	0.39	-0.30	0.38	291	227
7	-148.48	-3.29	1.56	1.46	1.39	0.22	0.44	-0.32	0.41	369	277
8	-178.29	-4.03	2.10	1.96	1.87	0.28	0.51	-0.35	0.46	500	385
9	-197.18	-5.01	2.88	2.75	2.59	0.43	0.55	-0.38	0.52	707	543
10	-236.38	-8.23	5.98	5.93	5.44	1.14	0.58	-0.59	0.58	805	642
11	-253.29	-9.07	6.72	6.67	6.11	1.31	0.58	-0.65	0.61	890	707
12	-267.91	-9.82	7.39	7.35	6.72	1.44	0.63	-0.70	0.63	959	759
13	-282.59	-10.66	-6.09	-1.71	-10.49	1.60	0.63	-0.76	0.66	1035	830
14	-298.47	-11.52	-6.09	-1.71	-10.50	1.77	0.63	-0.82	0.68	1115	874
15	-311.51	-12.26	-6.09	-1.71	-10.51	1.91	0.66	-0.92	0.71	1188	930
16	-327.27	-13.22	-6.09	-1.71	-10.51	2.07	0.66	-0.92	0.72	1272	991
17	-341.29	-14.19	-6.09	-1.71	-10.51	2.25	0.66	-0.97	0.73	1348	1043
18	-356.22	-15.31	-6.09	-1.71	-10.51	2.50	0.66	-1.06	0.74	1430	1102
19	-368.93	-16.52	-6.31	-1.80	-10.51	-2.88	-2.59	9.14	9.46	1500	1153
20	0.55	5.87	-7.79	-2.40	-10.48	-3.51	-2.59	9.58	8.98	945475	273194

	LOAD # 1 kn	STRAI # 3 uE L3	STRAI # 4 uE L4	STRAI # 5 uE L5	STRAI # 6 uE L6	STRAI # 7 uE L7	STRAI # 8 uE L8	STRAI # 9 uE L9	STRAI # 10 uE L10	STRAI # 11 uE P1	STRAI # 12 uE P2
1	0.02	-0	-0	-0	-0	0	-0	0	0	-0	4
2	-29.54	19	22	51	45	15	11	23	58	41	35
3	-59.00	37	43	97	91	29	27	44	118	85	73
4	-90.28	59	67	155	147	46	44	69	190	140	125
5	-118.52	78	88	213	210	60	60	91	284	197	196
6	-130.28	88	101	239	241	69	68	104	339	232	218
7	-148.48	101	115	289	340	79	79	119	422	291	294
8	-178.29	122	138	398	518	96	97	144	612	416	470
9	-197.18	148	172	549	668	116	124	176	875	595	577
10	-236.38	652	866	647	782	1113	2195	1115	996	703	663
11	-253.29	716	948	710	849	1208	2111	1221	1098	777	725
12	-267.91	782	1031	762	908	1281	2183	1313	1185	841	776
13	-282.59	849	1156	820	975	1349	2468	1404	1276	913	828
14	-298.47	914	1323	878	1046	1416	2682	1491	1372	984	880
15	-311.51	978	1518	934	1112	1505	2958	1570	1455	1049	936
16	-327.27	1059	1677	993	1186	1587	3273	1654	1553	1124	1000
17	-341.29	1160	1815	1045	1251	1668	3410	1724	1642	1194	1053
18	-356.22	1293	1965	1103	1320	1757	3551	1775	1740	1270	1110
19	-368.93	1407	2092	1153	1382	1859	3587	1823	1827	1335	1151
20	0.55	24	946415	424866	61	945949	1747	35	99	90	103

Table 4.3-PSN2 Readings of Steel Strains and Deflections for Beam PSN2-WD

	LOAD # 1 kn	STROK # 1 mm	LVDT # 1 mm	LVDT # 2 mm	LVDT # 3 mm	LVDT # 4 mm	LVDT # 5 mm	LVDT # 6 mm	LVDT # 7 mm	STRAI # 1 uE L1	STRAI # 2 uE L2	STRAI # 3 uE L3	STRAI # 4 uE L4	STRAI # 5 uE L5	STRAI # 6 uE L6
1	0.03	0.00	0.00	-0.00	-0.00	-0.04	0.00	0.03	-0.00	1	0	0	0	0	0
2	-31.65	-0.77	0.25	0.21	0.24	-0.02	0.00	0.01	0.09	58	64	20	0	42	0
3	-60.22	-1.37	0.51	0.48	0.48	-0.04	0.09	-0.01	0.16	114	123	38	0	81	0
4	-90.39	-1.96	0.81	0.76	0.75	-0.04	0.16	-0.04	0.23	184	183	57	0	128	0
5	-118.57	-2.52	1.13	1.07	1.03	0.00	0.21	-0.09	0.28	270	289	75	-24	188	-24
6	-130.12	-2.78	1.29	1.23	1.18	0.04	0.28	-0.13	0.32	312	345	83	0	218	0
7	-139.69	-2.98	1.41	1.34	1.29	0.05	0.28	-0.14	0.34	344	383	89	24	248	24
8	-148.73	-3.18	1.54	1.46	1.41	0.07	0.32	-0.15	0.35	398	424	95	0	275	0
9	-175.41	-3.87	2.03	1.94	1.85	0.16	0.36	-0.20	0.42	586	591	113	24	382	24
10	-191.58	-4.43	2.44	2.34	2.23	0.25	0.42	-0.25	0.48	698	697	126	0	487	0
11	-202.99	-4.98	2.89	2.82	2.62	0.32	0.47	-0.27	0.53	790	720	138	24	550	24
12	-213.70	-5.57	3.38	3.31	3.07	0.42	0.47	-0.29	0.58	843	759	176	0	590	0
13	-222.87	-5.87	3.62	3.55	3.28	0.46	0.47	-0.29	0.60	893	800	202	47	621	0
14	-237.07	-6:45	4.06	3.98	3.69	0.55	0.53	-0.32	0.66	978	882	508	24	669	-24
15	-251.39	-7.08	4.56	4.49	4.13	0.64	0.53	-0.34	0.71	1065	997	579	23	715	23
16	-268.84	-7.82	5.15	5.06	4.67	0.75	0.59	-0.34	0.75	1166	1065	659	-0	846	-0
17	-282.57	-8.38	5.58	5.48	5.05	0.84	0.59	-0.37	0.80	1251	1067	708	-0	912	-0
18	-296.76	-8.91	6.00	5.88	5.44	0.91	0.65	-0.37	0.83	1336	1139	763	23	983	23
19	-312.28	-9.63	6.55	6.43	5.95	1.05	0.65	-0.42	0.90	1422	1215	820	0	1058	0
20	-326.34	-10.17	6.99	6.84	6.34	1.12	0.65	-0.42	0.92	1506	1290	881	23	1132	23
21	-342.46	-10.94	7.58	7.41	6.87	1.27	0.73	-0.48	1.00	1592	1370	940	-0	1211	-0
22	-356.57	-11.53	8.06	7.87	7.30	1.34	0.73	-0.48	1.03	1673	1440	1003	-0	1280	-0
23	-372.74	-12.33	8.68	8.47	7.85	1.48	0.73	-0.53	1.10	1759	1519	1073	-0	1358	-0
24	-386.20	-12.93	9.17	8.96	8.30	1.55	0.73	-0.54	1.13	1837	1588	1142	-0	1426	-0
25	-401.85	-13.81	9.86	9.64	8.91	1.70	0.73	-0.60	1.20	1920	1677	1220	24	1499	24
26	-416.78	-14.67	-5.39	-3.45	-13.13	-17.21	16.72	4.19	5.81	2003	2017	1288	0	1315	0
27	-420.38	-15.48	-5.39	-3.45	-13.14	-17.22	16.72	13.61	5.34	2079	2100	1361	0	1374	0
28	0.59	-13.36	-6.45	-4.28	-13.15	-17.17	16.31	14.44	4.97	930184	160	28	23	22	23

	LOAD # 1 kn	STRAI # 7 uE L7	STRAI # 8 uE L8	STRAI # 9 uE L9	STRAI # 10 uE L10	STRAI # 11 uE P1	STRAI # 12 uE P2	STRAI # 13 uE W11	STRAI # 14 uE W12	STRAI # 15 uE W13	STRAI # 16 uE W14	STRAI # 17 uE W15	STRAI # 18 uE W16	STRAI # 19 uE W17	STRAI # 20 uE W18
1	0.03	0	0	0	0	0	-1	0	-1	0	0	0	0	0	0
2	-31.65	16	14	63	23	46	33	-4	-2	-1	-9	-4	3	-10	-7
3	-60.22	31	29	124	44	91	65	-7	-4	-2	-16	-6	5	-19	-13
4	-90.39	47	45	197	66	144	104	-11	-6	-4	-29	-11	7	-30	-22
5	-118.57	62	61	271	87	212	154	-13	-9	-5	-38	-14	9	-34	-28
6	-130.12	69	68	310	97	256	174	12	-9	-6	-56	-49	12	-36	-28
7	-139.69	74	74	339	104	292	197	11	-11	-7	-59	-50	12	-34	-31
8	-148.73	80	79	378	111	326	222	10	-12	-7	-63	-52	12	-31	-34
9	-175.41	94	95	527	132	470	355	8	-13	-4	-67	-51	13	12	-46
10	-191.58	105	109	633	146	556	418	14	-7	-15	49	-64	15	13	15
11	-202.99	117	129	748	158	621	452	18	-6	28	94	955	308	2	345
12	-213.70	151	477	810	182	668	479	953	236	949	102	1731	763	3	499
13	-222.87	202	537	864	189	707	506	1143	401	1097	110	1869	837	5	541
14	-237.07	641	621	957	448	772	554	1470	631	1340	125	2092	959	10	594
15	-251.39	929512	617	1055	570	837	604	2323	1217	1868	189	2478	1276	19	703
16	-268.84	929488	673	1167	744	914	668	2838	1529	2255	265	2720	1513	31	805
17	-282.57	929488	734	1280	791	979	723	3212	1685	2649	330	2863	1769	44	894
18	-296.76	929512	796	1377	840	1045	782	3630	1784	3088	384	2919	2059	58	969
19	-312.28	26125	859	1478	892	1120	834	3671	1967	4130	458	3100	2459	78	1078
20	-326.34	929512	911	1569	947	1185	892	3874	2101	5050	549	3302	2622	100	1146
21	-342.46	64459	974	1667	1004	1261	946	4015	2638	7378	689	3585	2853	133	1246
22	-356.57	929488	1051	1750	1063	1326	1007	4076	4021	8356	776	3797	2945	165	1328
23	-372.74	929488	1119	1846	1136	1402	1064	4105	6784	14901	867	3924	3019	214	1423
24	-386.20	929488	1192	1929	1220	1465	1115	4186	8748	20305	901	4020	3064	247	1497
25	-401.85	929464	1275	2026	1312	1542	1170	4431	12232	22735	951	4150	3178	303	1599
26	-416.78	929488	1351	2117	1403	1616	1226	4815	14157	23072	995	4274	3514	346	1647
27	-420.38	929488	1466	2194	1478	1670	1267	6344	17075	21378	1022	4286	3779	360	1672
28	0.59	91	930507	930434	162	103	937717	945711	9050	945143	945994	945308	945387	947672	948279

Table 4.3-PSN3 Readings of Steel Strains and Deflections for Beam PSN3-D2

	LOAD # 1 kn	STROK # 1 mm	LVDT # 1 mm	LVDT # 2 mm	LVDT # 3 mm	STRAI # 1 uE D1	STRAI # 2 uE D2	STRAI # 3 uE D3	STRAI # 4 uE D4	STRAI # 5 uE D5	STRAI # 6 uE D6	STRAI # 7 uE D7	STRAI # 8 uE D8	STRAI # 9 uE D9	STRAI # 1 uE D10	STRAI # 2 uE D11
1	-0.02	-0.00	0.00	0.00	0.00	0	0	0	0	1	0	0	0	0	0	1
2	-31.03	-0.85	0.33	0.26	0.26	-2	-1	-1	-10	11	5	-8	-7	-6	-6	-5
3	-58.12	-1.39	0.60	0.48	0.47	-7	-3	-3	-14	0	6	-12	-15	-12	-14	3
4	-89.77	-2.02	0.97	0.76	0.77	-12	-7	-6	-28	5	10	-2	-25	-18	-23	-13
5	-119.64	-2.60	1.32	1.03	1.04	-17	-12	-10	-14	5	13	7	-36	-24	-34	-19
6	-130.76	-2.89	1.49	1.16	1.18	-21	-12	-9	-14	6	15	-19	-42	-25	-39	-20
7	-141.40	-3.11	1.64	1.28	1.30	-23	-15	-10	-11	6	17	-24	-46	-28	-44	-22
8	-149.66	-3.29	1.76	1.37	1.39	-26	-16	-11	-12	5	18	-29	-49	-30	-47	-23
9	-176.30	-4.02	2.34	1.81	1.86	-30	-17	-13	-19	1	17	-69	-59	-35	-74	-26
10	-193.60	-4.57	2.78	2.15	2.21	-14	-12	-10	32	-16	16	-96	-56	-45	-84	-25
11	-208.07	-5.09	3.22	2.48	2.60	-23	-5	8	39	1158	81	-87	18	69	-90	-26
12	-222.82	-5.69	3.73	2.91	3.00	64	-0	29	45	1489	314	-91	22	179	-42	-13
13	-238.97	-6.53	4.48	3.48	3.64	4094	1033	1586	114	2133	605	-91	48	437	287	2
14	-248.52	-6.99	4.89	3.81	3.96	3365	1124	1853	168	2151	640	-94	54	494	513	19
15	-269.20	-7.70	5.52	4.31	4.46	4683	1344	2257	248	2595	653	-95	69	553	1494	1285
16	-285.09	-8.32	6.05	4.72	4.90	3505	1464	2818	343	2772	716	-94	95	641	1780	1437
17	-298.47	-8.80	6.46	5.05	5.25	4633	1587	3183	448	3860	728	-86	131	696	2039	1496
18	-314.64	-9.48	7.04	5.51	5.73	4091	1644	4161	602	3944	785	-81	183	794	2559	1606
19	-327.48	-9.99	7.48	5.86	6.10	5738	1714	5049	712	5132	803	-75	227	856	3835	1683
20	-344.66	-10.77	8.15	6.39	6.65	5350	1833	6501	824	4972	861	-63	295	964	5814	1899
21	-357.89	-11.32	8.63	6.77	7.05	6804	1935	7456	877	5741	907	-46	340	1028	7592	2091
22	-374.42	-12.20	9.38	7.37	7.67	5913	2351	8437	988	6218	1069	-17	413	1139	9378	5232
23	-387.50	-12.81	9.88	7.80	8.10	6085	3538	9156	1042	7278	1364	24	459	1201	10486	3629
24	-404.21	-13.76	10.65	8.45	8.77	3320	-28	9955	1151	7855	1767	70	525	1301	946840	570
25	-418.34	-14.40	11.14	8.91	9.24	3419	-2251	10528	1232	9196	2035	124	572	1362	946840	397
26	-433.84	-15.34	11.85	9.58	9.93	3095	-3644	8597	1347	8861	2338	200	639	1443	946840	769
27	-446.51	-15.95	-13.13	-7.26	-6.15	3193	-4657	9068	1426	9180	2610	243	680	1482	946840	954
28	-459.56	-16.69	-13.13	-7.26	-6.15	929590	-5750	10170	1470	8861	3510	283	691	1356	946840	970
29	-470.94	-17.33	-13.13	-7.26	-6.15	929590	-6034	9228	1476	8327	4174	309	697	1350	946840	971
30	-480.02	-17.89	-13.13	-7.26	-6.15	929590	-5896	8645	1491	8047	4794	324	722	1352	946840	945722
31	-494.21	-18.95	-13.13	-7.26	-6.15	929614	-5857	7325	1616	7880	6104	367	742	1326	946864	945697
32	-255.23	-20.45	-13.25	-7.85	-6.86	929637	-1677	5331	1264	2984	6021	384	614	1040	946840	945697
33	-286.96	-22.80	-13.25	-7.85	-6.86	929590	-1896	5266	1227	3713	6108	376	645	1040	946840	945673

	LOAD # 1 kn	STRAI # 3 uE D12	STRAI # 4 uE D13	STRAI # 5 uE D14	STRAI # 6 uE D15	STRAI # 7 uE D16	STRAI # 8 uE D17	STRAI # 9 uE D18	STRAI # 10 uE L1	STRAI # 11 uE L2	STRAI # 12 uE L3	STRAI # 13 uE L4	STRAI # 14 uE L5	STRAI # 15 uE L6	STRAI # 16 uE P1
1	-0.02	0	0	39	0	0	0	0	1	0	0	1	0	1	1
2	-31.03	-3	-10	570	7	-18	-9	-4	72	28	72	27	51	23	59
3	-58.12	8	-4	646	31	-19	1	5	151	66	126	42	95	37	97
4	-89.77	-12	-27	667	19	-52	-25	-12	230	73	212	70	167	56	177
5	-119.64	-15	-6	680	27	-58	-37	-19	327	98	297	92	245	74	247
6	-130.76	-19	-13	834	31	-52	-39	-20	377	109	339	103	285	83	279
7	-141.40	-21	-19	901	35	-47	-43	-22	422	117	379	113	316	90	306
8	-149.66	-22	-23	914	37	-44	-48	-25	469	122	408	118	343	95	326
9	-176.30	-26	-45	1347	42	12	-63	-40	661	145	726	125	475	106	488
10	-193.60	-21	82	2222	41	61	-12	-51	822	168	763	58	445	72	339
11	-208.87	-19	132	2218	38	81	16	-64	923	195	989	160	623	145	681
12	-222.82	-9	724	2306	27	116	140	802	1047	245	707	-72	331	-4	-0
13	-238.97	11	831	3114	159	128	182	1174	1174	507	1214	362	761	702	852
14	-248.52	34	838	7925	358	140	216	1376	1265	542	1305	511	815	771	914
15	-269.20	1226	872	35948	1206	184	344	1747	1375	594	1433	627	908	855	1015
16	-285.09	1528	929	138661	1440	227	412	1755	1490	646	1548	673	986	942	1104
17	-298.47	1601	987	73629	1679	267	484	1914	1584	705	1643	725	1060	1029	1179
18	-314.64	3023	1077	47811	1960	311	567	1993	1697	775	1754	804	1134	1122	1267
19	-327.48	4002	1158	46554	2244	362	642	2149	1789	841	1846	900	1197	1196	1334
20	-344.66	4717	1237	5803	2811	408	709	2145	1908	929	1970	997	1277	1281	1429
21	-357.89	5284	1300	6234	3130	445	759	2211	2001	1018	2066	1072	1341	1351	1494
22	-374.42	5856	1361	39960	4529	470	812	2198	2118	1119	2188	1164	1422	1433	1584
23	-387.50	6251	1407	41740	5987	502	852	2229	2211	1212	2284	1227	1488	1491	1653
24	-404.21	6844	1456	8740	7549	511	880	2227	2329	1331	2405	1284	1563	1573	1740
25	-418.34	6921	1503	7386	7839	550	928	2296	2426	1448	2507	1333	1631	1643	1810
26	-433.84	945251	1565	508	8960	573	970	2293	2536	1541	2628	1394	1703	1731	1896
27	-446.51	945251	1619	-145	9821	600	1011	2382	2624	1616	2724	1447	1766	1802	1964
28	-459.56	945226	1684	-227	9940	650	1070	2523	2721	1699	2836	1493	1832	1899	2034
29	-470.94	945226	1720	801	10103	675	1093	2583	2801	1727	2929	1531	1887	1958	2097
30	-480.02	945252	1760	1572	10246	714	1140	2670	2911	1756	3009	1556	1930	2005	2140
31	-494.21	945227	944734	2599	10265	728	1146	2733	2994	1750	3194	1607	2021	2076	2259
32	-255.23	945228	944735	937650	8788	486	815	1078	1678	1027	1866	943558	993	1186	1229
33	-286.96	945253	944760	937675	944369	421	789	2537	1880	1093	2077	943483	1112	1304	1366

Table 4.3-PSN4 Readings of Steel Strains and Deflections for Beam PSN4-WDH

	LOAD # 1 kn	STROK # 1 mm	LVDT # 1 mm	LVDT # 2 mm	LVDT # 3 mm	STRAI # 1 uE L1	STRAI # 2 uE L2	STRAI # 3 uE L3	STRAI # 4 uE L4	STRAI # 5 uE L5	STRAI # 6 uE L6	STRAI # 7 uE P1	STRAI # 8 uE P2	STRAI # 9 uE W1	STRAI # 10 uE W2	STRAI # 11 uE W3
1	-0.04	0.00	0.00	0.00	0.00	0	0	0	0	0	-6	-9	5	0	0	-0
2	0.17	-0.21	0.08	0.05	0.06	10	9	1	-18	11	-699	2	2	2	3	-2
3	-29.45	-0.94	0.36	0.26	0.28	70	31	59	2	56	-711	46	34	-0	3	-2
4	-60.40	-1.54	0.66	0.50	0.54	148	53	117	16	108	-831	103	66	-3	3	-2
5	-89.77	-2.05	0.94	0.71	0.76	226	74	177	34	161	-694	141	105	-5	2	-3
6	-118.95	-2.57	1.25	0.95	1.02	316	95	244	54	226	-267	193	152	-8	2	-4
7	-128.88	-2.79	1.37	1.04	1.11	352	105	272	62	254	226	212	164	-8	2	-4
8	-138.46	-2.98	1.50	1.13	1.21	388	114	303	71	287	692	239	178	-8	2	-4
9	-150.15	-3.22	1.66	1.25	1.34	445	122	349	78	349	1350	277	201	-9	1	-6
10	-178.71	-3.92	2.16	1.63	1.75	621	151	485	104	531	2495	431	337	-9	2	-3
11	-195.14	-4.36	2.50	1.89	2.02	738	169	575	120	643	2785	549	386	-9	5	-4
12	-207.66	-4.78	2.84	2.15	2.30	825	183	652	129	719	3541	611	425	-9	10	-2
13	-223.00	-5.48	3.46	2.62	2.83	913	211	770	147	785	6652	696	456	-8	16	6
14	-237.51	-6.25	4.13	3.14	3.41	1001	618	862	209	853	6848	752	509	44	14	448
15	-250.85	-6.89	4.68	3.59	3.85	1081	735	957	467	916	934253	799	529	1143	745	1050
16	-266.14	-7.57	5.29	4.08	4.34	1182	817	1069	568	990	11180	873	577	2142	1409	2078
17	-284.14	-8.25	5.88	4.53	4.81	1276	881	1167	656	1064	6284	940	618	3089	2152	3744
18	-298.08	-8.82	6.38	4.92	5.22	1371	942	1264	731	1140	5569	1000	648	3883	2372	4916
19	-314.05	-9.47	6.92	5.34	5.67	1463	1010	1357	797	1212	5384	1046	681	5135	2533	6242
20	-329.54	-10.07	7.44	5.75	6.11	1558	1101	1468	882	1292	4025	1133	723	9123	2559	7641
21	-344.23	-10.72	7.98	6.18	6.57	1641	1170	1549	962	1361	3018	1208	752	12195	2654	9035
22	-358.77	-11.28	8.50	6.57	6.99	1728	1249	1633	1086	1432	2687	1273	800	16747	2669	10773
23	-375.01	-11.92	9.04	6.99	7.44	1801	1316	1702	1143	1483	1204	1339	819	18881	2743	945423
24	-386.08	-12.86	9.86	7.65	8.07	1949	1452	1841	1272	1584	1625	1443	885	26378	2765	945397
25	-405.01	-13.85	10.69	8.32	8.69	2051	1537	1944	1355	1655	-1273	1593	915	69680	2847	945371
26	-418.78	-14.73	11.40	8.92	8.82	2158	1616	2053	1438	1737	-1518	1589	383	325743	2909	945449
27	-432.22	-15.42	-11.31	-5.23	-11.48	2241	1658	2134	1512	1796	-573	1620	1036	939248	2919	945372
28	-439.17	-15.84	-11.32	-5.23	-11.48	2285	1683	2177	1641	1829	908	1655	1033	947391	2926	945372
29	-446.13	-16.24	-11.32	-5.23	-11.48	2326	1712	2218	1701	1858	2723	1681	1055	947366	2937	945398
30	-456.25	-16.92	-11.32	-5.23	-11.48	2393	1738	2286	1828	1908	44388	1838	1068	947391	2949	945398
31	-463.99	-17.56	-11.32	-5.23	-11.48	2444	1740	2339	1894	1945	-952	1877	1119	947341	2962	945423

	LOAD # 1 kn	STRAI # 12 uE W4	STRAI # 13 uE W5	STRAI # 14 uE W6	STRAI # 15 uE W7	STRAI # 16 uE W8	STRAI # 17 uE W9	STRAI # 18 uE W10	STRAI # 19 uE W11	STRAI # 20 uE W12	STRAI # 21 uE W13	STRAI # 22 uE W14	STRAI # 23 uE W15	STRAI # 24 uE W16	STRAI # 25 uE W17	STRAI # 26 uE W18
1	-0.04	1	0	-16	0	0	0	-0	41	1	0	0	1	1	0	0
2	0.17	2	2	-3845	-4	-40	-9	-0	-334	0	1	25	0	1	-1	-2
3	-29.45	-5	0	-3851	-14	-45	-9	-6	-185	-1	-6	25	2	-7	-8	-2
4	-60.40	-12	-2	-3908	-24	-69	-11	-10	-238	-3	-14	50	5	-17	-15	-3
5	-89.77	-18	-4	-3908	-34	-74	-10	-15	-237	-4	-22	50	6	-26	-22	-3
6	-118.95	-24	-6	-3909	-44	-80	-10	-21	-241	-5	-29	50	7	-37	-29	-3
7	-128.88	-25	-6	-3945	-48	-82	-9	-20	400	-6	-31	25	10	-40	-31	-2
8	-138.46	-28	-6	-3951	-49	-82	-7	-20	728	-6	-32	50	11	-40	-33	0
9	-150.15	-33	-8	-3956	-47	-83	-7	-22	694	-7	-36	50	12	-40	-35	-0
10	-178.71	-32	-6	-3993	-36	-90	-8	-23	1016	-1	-36	50	14	37	-48	3
11	-195.14	-29	-5	-4000	-31	-86	-7	-23	648	2	-9	50	12	109	-64	-1
12	-207.66	7	-17	-4028	-23	-43	11	-23	566	-10	6	-0	23	158	-55	-3
13	-223.00	193	349	-4079	-15	182	200	-30	499	70	42	-25	306	147	11	736
14	-237.51	553	894	-4101	-13	305	640	492	1066	1787	61	25	1239	162	53	1295
15	-250.85	907	1571	-3620	-6	515	1015	899	3635	2629	76	50	1632	190	119	1445
16	-266.14	900	2420	-3019	3	700	1281	1303	4997	3678	103	50	2187	224	212	1674
17	-284.14	1010	2578	-1796	14	874	1503	1600	8838	4218	142	25	2471	263	296	1865
18	-298.08	1045	2473	1032	23	957	1581	1910	8944	5003	173	50	2792	320	375	2034
19	-314.05	1089	2657	-2147	29	958	1582	2357	9171	6311	212	25	3259	366	458	2210
20	-329.54	1185	2876	-2053	38	963	1590	2870	5546	8602	254	50	3551	506	523	2357
21	-344.23	1275	3028	350	50	963	1656	3593	15728	11478	301	24	3855	579	615	2546
22	-358.77	1345	3226	-157	69	978	1734	4049	15993	14467	330	50	4171	646	698	2720
23	-375.01	1421	3272	1329	97	1015	1814	4768	15276	13438	370	24	4408	711	792	2918
24	-386.08	1490	3345	4330	170	1102	1958	5567	15298	17019	427	24	4675	825	929	3282
25	-405.01	1578	3447	4053	220	1210	2061	6163	14047	16482	486	-1	5290	920	1051	3657
26	-418.78	1644	3524	4809	267	1346	2206	6199	13552	955363	540	151	5991	1009	1153	4135
27	-432.22	1697	3553	6761	296	1394	2210	6035	13573	947599	612	75	6493	1081	1234	4554
28	-439.17	1739	3560	8108	322	1465	2253	5555	13627	947599	660	75	6928	1122	1273	4895
29	-446.13	1771	3569	9403	344	1515	2290	4731	13655	947573	697	24	7343	1146	1299	5107
30	-456.25	1827	3565	11667	387	1608	2358	3085	13680	947573	758	49	8138	1190	1332	5718
31	-463.99	1871	3548	13767	433	1688	2411	944102	13718	947651	820	49	8847	1231	1358	5947

Table 4.3-PSN5 Readings of Steel Strains and Deflections for Beam PSN5-S6M

	LOAD # 1 kn	STROK # 1 mm	LVDT # 1 mm	LVDT # 2 mm	LVDT # 3 mm	STRAI # 1 uE L1	STRAI # 2 uE L2	STRAI # 3 uE L3	STRAI # 4 uE L4	STRAI # 5 uE L5	STRAI # 6 uE L6	STRAI # 7 uE P1	STRAI # 8 uE P2	STRAI # 9 uE S1	STRAI # 10 uE S2	STRAI # 11 uE S3
1	0.03	0.00	-0.00	0.00	0.00	1	1	4	1	1	-1	1	0	-3	1	-0
2	-31.41	-0.77	0.29	0.23	0.23	66	25	72	23	47	22	49	39	-76	3	1
3	-61.26	-1.34	0.56	0.44	0.45	135	49	130	45	93	27	97	79	-86	5	1
4	-89.87	-1.94	0.94	0.73	0.78	193	71	211	65	152	46	166	129	-111	6	1
5	-119.73	-2.53	1.28	0.98	1.05	262	95	317	86	225	63	245	188	-122	7	0
6	-130.96	-2.82	1.49	1.14	1.22	297	107	363	97	260	62	287	218	-166	9	0
7	-139.37	-2.99	1.61	1.23	1.32	327	115	397	104	283	63	315	237	-180	10	1
8	-151.06	-3.23	1.77	1.35	1.45	380	123	434	112	321	82	349	266	-190	10	1
9	-179.04	-3.88	2.26	1.72	1.84	524	145	579	134	450	88	466	387	-231	13	2
10	-193.03	-4.28	2.57	1.96	2.09	623	157	669	146	562	103	555	488	-258	14	3
11	-209.36	-4.78	2.99	2.28	2.44	759	170	772	159	626	114	654	541	-300	19	7
12	-222.57	-5.30	3.46	2.65	2.81	861	188	855	176	677	122	730	582	-310	34	14
13	-227.85	-5.82	3.95	3.00	3.26	924	209	898	395	702	124	772	603	-317	31	26
14	-252.91	-6.88	4.90	3.78	4.02	1072	490	1010	562	789	523	886	685	1566	820	1319
15	-267.96	-7.48	5.44	4.18	4.46	1167	598	1098	688	845	577	959	739	2240	987	1614
16	-282.66	-8.10	5.98	4.61	4.91	1267	698	1178	758	905	669	1031	790	3433	1088	2068
17	-296.42	-8.66	6.49	5.01	5.33	1360	790	1252	808	963	736	1100	840	4861	1158	2817
18	-312.13	-9.37	7.12	5.50	5.86	1464	892	1338	854	1028	782	1174	895	6470	1232	3724
19	-328.13	-10.06	7.77	5.98	6.38	1571	1006	1432	899	1100	854	1255	955	8636	1268	4811
20	-343.40	-10.80	8.44	6.50	6.95	1666	1095	1516	931	1162	928	1329	1009	8533	1335	6091
21	-356.83	-11.40	8.97	6.94	7.41	1759	1184	1670	977	1220	978	1399	1060	954375	1361	7461
22	-372.82	-12.24	9.72	7.53	8.05	1911	1298	1703	1052	1286	1031	1476	1117	954844	1421	9384
23	-386.30	-12.88	10.29	7.99	8.54	2013	1391	1780	1127	1343	1082	1544	1167	954869	1440	10934
24	-402.93	-13.79	11.05	8.64	9.23	2128	1509	1869	1217	1413	1154	1623	1228	954894	1495	12991
25	-417.14	-14.47	11.60	9.13	9.76	2227	1614	1996	1308	1475	1218	1694	1281	954869	1514	15222
26	-431.96	-15.35	-12.16	-5.05	-4.85	2331	1737	2061	1410	1538	1273	1767	1337	954894	1554	17622
27	-444.45	-16.04	-12.16	-5.05	-4.85	2422	1848	2133	1494	1596	1325	1832	1388	954894	1567	87100
28	-458.38	-16.93	-12.16	-5.05	-4.85	2520	1973	2211	1593	1659	1393	1905	1446	954844	1595	78013
29	-472.96	-17.86	-12.16	-5.05	-4.85	2623	2110	2298	944209	1726	1436	1983	1507	954894	1616	105920
30	-488.81	-19.00	-12.16	-5.05	-4.85	2730	2273	2393	944209	1802	1497	2069	1578	954845	1642	88682
31	-481.57	-19.89	-12.16	-5.08	-4.85	2798	2386	2458	944160	1856	1554	2129	1633	954894	1666	942804

	LOAD # 1 kn	STRAI # 12 uE S4	STRAI # 13 uE S5	STRAI # 14 uE S6	STRAI # 15 uE S7	STRAI # 16 uE S8	STRAI # 17 uE S9	STRAI # 18 uE S10	STRAI # 19 uE S11	STRAI # 20 uE S12	STRAI # 21 uE S13	STRAI # 22 uE S14	STRAI # 23 uE S15	STRAI # 24 uE S16	STRAI # 25 uE S17	STRAI # 26 uE S18
1	0.03	0	-0	-0	-0	0	-0	0	0	1	-0	-0	0	-0	-0	0
2	-31.41	-24	-7	1	-26	-8	-1	-3	1	3	-14	-5	-0	-7	-6	5
3	-61.26	-24	-11	5	-50	-14	0	-5	2	4	-28	-11	-0	-16	-12	8
4	-89.87	0	-17	7	-65	-21	1	-7	1	3	-45	-19	-2	-29	-20	11
5	-119.73	0	-23	11	-87	-28	2	-10	-1	3	-50	-25	-3	-42	-30	13
6	-130.96	0	-27	13	-89	-33	1	-11	-0	2	-49	-27	-2	-47	-35	14
7	-139.37	0	-28	14	-91	-35	2	-11	1	3	-50	-27	-2	-56	-38	17
8	-151.06	0	-31	14	-98	-40	1	-12	-0	4	-60	-31	-2	-66	-43	17
9	-179.04	25	-37	17	-137	-48	-1	-15	-1	3	-88	-38	-4	-49	-57	18
10	-193.03	0	-38	17	-92	-71	-6	-18	0	6	-113	-39	-5	7	-61	17
11	-209.36	25	-35	19	73	-91	-31	-19	7	15	-53	-38	-12	-58	-8	4
12	-222.57	0	-51	-6	174	1	27	-16	13	8	90	-32	-11	-71	103	-8
13	-227.85	0	-4	-2	163	35	255	489	33	1091	268	511	784	-65	458	89
14	-252.91	25	1350	483	160	563	943	1461	63	1526	269	1098	1113	-77	569	272
15	-267.96	25	1692	739	165	678	1120	2170	79	1671	295	1443	1335	-79	634	435
16	-282.66	25	2226	981	177	789	1311	2778	96	1773	337	1650	1507	-78	706	568
17	-296.42	0	2832	1374	195	852	1679	3450	104	1829	387	1775	1617	-76	760	679
18	-312.13	-24	3722	1649	212	975	2017	4664	120	1928	447	1896	1748	-73	845	847
19	-328.13	25	4586	1837	247	1094	2451	5743	129	2037	510	1998	1857	-64	910	1026
20	-343.40	0	5058	2033	255	1192	2893	5845	149	2246	572	2126	1962	-56	1008	1226
21	-356.83	0	5348	2180	280	1245	3631	6210	162	2367	627	2213	2024	-47	1071	1355
22	-372.82	-1	6006	2386	301	1297	4474	5580	191	2578	694	2348	2122	-34	1185	1498
23	-386.30	-1	6494	2541	328	1319	5147	6204	205	2709	744	2447	2200	-25	1259	1613
24	-402.93	-1	7399	2803	346	1369	5852	5642	236	2980	808	2630	2319	-9	1387	1748
25	-417.14	-0	8046	3012	368	1393	6128	944684	253	3160	852	2759	2413	5	1470	1843
26	-431.96	24	8889	3391	389	1398	5869	944758	284	3493	903	2988	2547	27	1593	1949
27	-444.45	-0	9368	3729	409	1412	6032	944684	296	3694	937	3134	2659	40	1675	2028
28	-458.38	49	9907	4241	428	1433	6082	944684	322	3999	978	3358	2802	61	1785	2116
29	-472.96	-3254	10362	4793	433	1427	6068	941528	346	4301	1028	3628	2961	82	1905	2219
30	-488.81	-98	11084	5728	473	1463	6057	944635	403	4745	1076	4004	3216	95	2034	2338
31	-481.57	0	11563	6494	488	1482	5952	944734	504	5138	1108	4237	3481	119	2177	2469

Table 4.3-PSN6 Readings of Steel Strains and Deflections for Beam PSN6-WS

	LOAD # 1 kn	STROK # 1 mm	LVDT # 1 mm	LVDT # 2 mm	LVDT # 3 mm	STRAI # 1 uE L1	STRAI # 2 uE L2	STRAI # 3 uE L3	STRAI # 4 uE L4	STRAI # 5 uE L5	STRAI # 6 uE L6	STRAI # 7 uE P1	STRAI # 8 uE P2	STRAI # 9 uE W1	STRAI # 10 uE W2	STRAI # 11 uE W3
1	0.03	0.00	0.00	0.00	0.00	-0	-1	-1	-0	-0	0	0	-0	-2	-0	-1
2	-31.11	-0.79	0.28	0.22	0.22	64	24	64	21	48	16	47	37	-12	-2	-1
3	-59.59	-1.34	0.54	0.42	0.43	127	46	128	40	95	37	91	71	-15	-3	-1
4	-89.73	-1.95	0.88	0.68	0.72	206	74	230	63	162	56	149	118	-26	-3	-2
5	-119.31	-2.52	1.21	0.93	0.97	293	98	325	85	242	66	216	169	-29	-5	-3
6	-130.24	-2.76	1.36	1.05	1.10	330	110	362	94	273	71	248	191	-35	-5	-2
7	-140.10	-2.97	1.51	1.15	1.22	364	117	395	101	308	76	282	211	-37	-6	-4
8	-150.47	-3.18	1.63	1.25	1.31	403	127	442	110	341	92	314	233	-39	-7	-4
9	-178.13	-3.83	2.10	1.60	1.69	558	153	600	135	466	109	454	388	-46	-6	-1
10	-193.98	-4.26	2.43	1.86	1.95	659	172	700	144	537	112	530	493	-53	-7	-1
11	-208.11	-4.69	2.79	2.12	2.24	753	193	792	157	607	132	601	598	-55	-3	2
12	-222.27	-5.15	3.17	2.42	2.54	847	211	878	168	674	134	668	637	-57	5	1
13	-236.89	-5.96	3.89	3.00	3.13	946	282	970	350	724	265	736	659	130	9	38
14	-253.16	-6.58	4.42	3.42	3.57	1039	368	1059	537	782	429	805	696	711	21	364
15	-267.18	-7.19	4.97	3.87	3.99	1126	488	1133	647	849	530	882	731	1564	301	1448
16	-281.86	-7.80	5.49	4.28	4.40	1219	571	1212	701	924	555	956	775	2085	1019	1611
17	-297.67	-8.38	6.00	4.68	4.82	1310	648	1294	784	1002	614	1033	829	2526	1610	1844
18	-312.76	-9.03	6.55	5.13	5.27	1405	714	1376	839	1074	676	1104	884	2796	1933	2286
19	-325.57	-9.52	6.99	5.46	5.62	1488	773	1449	886	1137	731	1164	927	2712	2102	2502
20	-343.94	-10.34	7.69	6.01	6.20	1604	849	1550	945	1220	810	1246	977	2550	2326	2784
21	-358.20	-10.86	8.15	6.36	6.57	1695	909	1634	1003	1290	865	1309	1015	2561	2422	2942
22	-374.30	-11.56	8.76	6.83	7.08	1797	984	1721	1066	1363	932	1379	1057	2559	2538	943128
23	-387.75	-12.12	9.23	7.21	7.48	1883	1055	1796	1110	1422	976	1435	1096	2585	2649	943079
24	-403.59	-12.89	9.90	7.74	8.03	1985	1129	1889	1161	1495	1036	1508	1141	2587	2767	943079
25	-417.69	-13.45	10.38	8.15	8.45	2075	1197	1969	1213	1560	1085	1569	1184	2613	2840	943079
26	-432.90	-14.22	11.02	8.69	9.01	2176	1279	2058	1277	1632	1144	1636	1226	2621	2923	943103
27	-446.58	-14.85	11.52	9.14	9.47	2266	1359	2138	1355	1696	1188	1697	1265	2636	2962	943103
28	-460.69	-15.67	-11.94	-3.86	0.44	2359	1457	2223	1496	1762	1248	1763	1303	2628	2993	943103
29	-472.74	-16.48	-11.95	-3.86	0.44	2455	1568	2312	1602	1829	1308	1831	1335	2642	3019	943128
30	-483.26	-17.68	-11.95	-3.86	0.44	2534	1760	2366	1673	1870	1566	1876	1349	2621	3020	943104
31	-491.04	-19.53	-11.95	-3.86	0.44	2619	1704	2431	1771	1913	1724	1918	1366	2605	2992	943079

	LOAD # 1 kn	STRAI # 12 uE W4	STRAI # 13 uE W5	STRAI # 14 uE W6	STRAI # 15 uE W7	STRAI # 16 uE W8	STRAI # 17 uE W9	STRAI # 18 uE W10	STRAI # 19 uE W11	STRAI # 20 uE W12	STRAI # 21 uE W13	STRAI # 22 uE W14	STRAI # 23 uE W15	STRAI # 24 uE W16	STRAI # 25 uE W17	STRAI # 26 uE W18
1	0.03	-1	-1	-1	-1	-2	-1	-1	-0	-0	0	-0	-0	-1	0	0
2	-31.11	-8	1	4	-8	-41	-18	-1	-3	-0	-8	-3	4	-10	-6	4
3	-59.59	-13	-2	7	-15	-47	-17	-4	-4	-0	-15	-6	7	-22	-11	6
4	-89.73	-19	-11	11	-25	-58	-54	-5	-7	-0	-21	-8	6	-29	-15	6
5	-119.31	-21	-15	14	-29	-65	-53	-8	-9	-0	-29	-10	10	-44	-22	7
6	-130.24	-21	-15	17	-29	-66	-52	-9	-9	0	-32	-10	12	-49	-24	11
7	-140.10	-22	-16	17	-29	-70	-52	-11	-9	0	-39	-11	15	-52	-26	21
8	-150.47	-22	-16	21	-27	-72	-55	-12	-10	0	-45	-12	17	-53	-28	24
9	-178.13	-15	-14	24	-25	-80	-54	-14	-9	3	-29	-12	20	-11	-41	23
10	-193.98	-13	-13	26	-21	-88	-56	-11	-7	7	1	-9	17	60	-45	20
11	-208.11	35	-6	32	-0	-87	-54	-8	-1	12	151	-23	14	216	-40	20
12	-222.27	90	102	23	24	-64	-51	-6	1	13	363	-43	-11	236	123	35
13	-236.89	115	1187	320	30	-7	853	179	3	146	683	318	30	231	802	72
14	-253.16	200	1444	836	25	208	1020	581	20	481	773	917	334	233	926	410
15	-267.18	349	1686	1490	28	585	1288	920	51	678	776	1239	807	241	965	635
16	-281.86	419	1927	1785	29	755	1324	1233	211	838	800	1480	1112	253	1013	831
17	-297.67	558	2214	2048	34	930	1477	1509	533	983	862	1662	1307	264	1046	976
18	-312.76	649	2458	2326	42	1087	1504	1748	719	1108	939	1851	1509	281	1098	1112
19	-325.57	736	2557	2499	53	1185	1566	1963	842	1191	996	2028	1671	294	1144	1215
20	-343.94	800	2694	2744	73	1298	1500	2252	984	1300	1059	2264	1903	313	1223	1345
21	-358.20	899	2648	2855	94	1377	1587	2502	1070	1332	1130	2467	2067	335	1288	1449
22	-374.30	986	2974	2986	118	1424	1451	2698	1147	1375	1207	2755	2273	354	1368	1546
23	-387.75	1038	3016	3029	137	1436	1369	2874	1182	1400	1275	2997	2426	372	1435	1603
24	-403.59	1041	3018	3148	162	1431	1327	3097	1228	1439	1354	3270	2585	394	1525	1657
25	-417.69	1063	2990	3341	183	1432	1335	3353	1253	1458	1426	3459	2689	415	1593	1710
26	-432.90	1090	678	3651	220	1461	1333	3735	1293	1498	1488	945084	2786	437	1666	1753
27	-446.58	1118	462	3759	282	1493	1350	4102	1304	1516	1537	945084	2807	456	1727	1790
28	-460.69	1082	13	941992	327	1574	1394	4550	1320	1544	1567	945133	2751	477	1787	1831
29	-472.74	1074	88	941968	389	1629	1413	5059	1328	1573	1587	945109	944486	503	1848	1956
30	-483.26	1066	94	941992	549	1658	1375	5064	1249	947080	1533	945133	944511	520	1696	1314
31	-491.04	1070	158	942017	693	1647	931	2933	1234	947104	1523	945109	944486	535	1665	1271

Table 4.4-PSN1 Measured Crack Angles for Beam PSN1-0

Load (2P) (KN)	Side A								Side B							
	Station								Station							
	11	12	13	14	15	16	17	18	11	12	13	14	15	16	17	18
150	-	-	-	-	-	-	-	-	-	-	-	80	-	-	-	-
180	-	-	-	-	-	-	-	90	-	-	-	-	-	-	-	70
208	-	-	50	45	-	-	-	60	-	20	50	80	-	20	45	-
224	15	25	28	-	-	25	30	40	10	20	90	-	-	-	-	65

Table 4.4-PSN2 Measured Crack Angles for Beam PSN2-WD

Load (2P) (KN)	Side A								Side B							
	Station								Station							
	11	12	13	14	15	16	17	18	11	12	13	14	15	16	17	18
195	-	-	-	55	-	-	-	50	-	-	60	55	-	-	-	70
210	-	-	58	-	-	-	40	-	-	-	33	-	-	-	45	-
225	-	20	-	-	-	-	-	-	-	30	-	-	-	-	25	-
240	30	35	-	-	-	-	-	-	-	-	-	-	-	-	-	-
255	-	-	-	-	-	-	-	-	15	-	-	-	-	20	30	-
265	30	-	-	-	-	30	-	-	-	-	-	-	-	-	-	-
270	-	-	-	-	-	-	-	-	-	20	-	-	-	-	30	-
330	-	-	-	-	-	-	-	-	-	20	-	80	20	20	-	-

Table 4.4-PSN3 Measured Crack Angles for Beam PSN3-D2

Load (2P) (KN)	Side A								Side B							
	Station								Station							
	11	12	13	14	15	16	17	18	11	12	13	14	15	16	17	18
195	-	-	-	-	-	-	-	85	-	-	-	-	-	-	-	-
210	-	-	35	-	-	-	50	-	-	-	-	73	-	-	-	80
225	-	25	-	-	-	-	-	-	-	-	45	-	-	-	50	-
240	27	30	-	-	-	30	30	-	-	-	45	-	-	-	40	-
255	40	-	-	-	-	-	-	-	30	35	-	-	-	30	30	-
270	-	-	-	-	-	-	-	-	30	-	-	-	-	-	-	-
300	-	-	-	-	-	-	-	-	30	30	-	-	-	-	-	-
360	30	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
420	30	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Table 4.4-PSN4 Measured Crack Angles for Beam PSN4-WDH

Load (2P) (KN)	Side A								Side B							
	Station								Station							
	11	12	13	14	15	16	17	18	11	12	13	14	15	16	17	18
180	-	-	-	70	-	-	-	60	-	-	-	80	-	-	-	-
210	-	-	55	-	-	-	45	-	-	-	-	70	-	-	60	-
225	-	30	30	-	-	-	30	-	-	-	38	-	-	-	40	-
240	22	23	-	-	23	23	-	-	-	-	-	-	-	-	40	-
255	-	-	-	-	-	-	-	-	25	20	-	-	-	-	35	-
270	-	-	-	-	-	-	-	-	80	-	-	-	-	25	-	-

Table 4.4-PSN5 Measured Crack Angles for Beam PSN5-S6M

Load (2P) (KN)	Side A								Side B							
	Station								Station							
	11	12	13	14	15	16	17	18	11	12	13	14	15	16	17	18
195	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	70
210	-	-	-	60	-	-	-	60	-	-	-	-	-	-	-	-
225	-	-	50	50	-	-	-	-	-	-	30	45	-	-	-	48
240	-	30	30	-	-	30	30	-	-	-	30	-	-	-	-	-
255	30	-	-	-	-	-	-	-	30	30	-	-	-	30	30	-
270	-	-	-	-	-	-	-	-	25	-	-	-	-	-	30	-
300	-	-	-	-	-	-	-	-	20	-	-	-	-	-	-	-

Table 4.4-PSN6 Measured Crack Angles for Beam PSN6-WS

Load (2P) (KN)	Side A								Side B							
	Station								Station							
	11	12	13	14	15	16	17	18	11	12	13	14	15	16	17	18
180	-	-	-	-	-	-	-	80	-	-	-	-	-	-	-	85
210	-	-	-	55	-	-	-	55	-	-	-	-	-	-	-	-
225	-	-	35	40	-	-	-	-	-	-	-	60	-	-	55	60
240	20	25	35	-	-	-	35	-	-	35	35	-	-	30	35	-
270	-	-	-	-	-	-	-	-	30	30	-	-	-	-	30	-
300	20	30	-	-	-	-	-	-	30	-	-	-	-	-	30	-

Table 5.1-PSN1 Concrete Strains in Beam PSN1-0

STATION	APPLIED SHEAR (KN)	30.0	60.0	75.0	90.0	105.0	112.0	120.0	127.5	135.0	142.5
		SIDE A									
		Concrete Strains (x10^6)									
2		56	89	97	113	105	299	371	452	557	686
3		56	161	186	186	234	880	1170	1307	1372	1501
4		40	121	153	258	387	904	1186	1307	1364	1469
5		153	234	347	436	525	710	904	985	1041	1098
6		161	347	533	791	1178	1299	1574	1711	1840	1913
7		-8	-40	0	-16	-48	-137	-121	-169	-218	-234
8		-8	16	8	-24	-16	-145	-186	-202	-242	-315
9		0	0	-16	16	0	533	1073	1307	1549	1767
9A		-8	8	16	73	258	702	662	694	670	694
10		129	323	533	767	904	976	1227	1380	1493	1646
	H	16	56	48	89	89	-186	-291	-379	-387	-387
11	V	0	-8	0	0	0	3817	6020	7174	8457	9684
	D	32	40	73	81	105	4422	6634	7876	9151	10410
	H	40	97	105	121	105	1558	2373	2825	3293	3696
12	V	16	-16	0	-8	24	4890	7263	8570	9878	11169
	D	40	73	97	129	145	5189	6755	8885	10200	11500
	H	48	113	137	210	194	751	872	920	993	1041
13	V	-24	-32	-16	8	178	4560	6545	7715	8837	9934
	D	32	89	105	178	557	5463	7739	9014	10249	11484
	H	40	153	161	242	726	726	815	880	904	976
14	V	-32	-48	-32	-40	202	1138	1122	1170	1186	1275
	D	40	73	89	194	815	1727	1800	1856	1888	2009
	H	16	32	24	48	32	-161	-226	-291	-323	-363
15	V	-8	0	8	8	16	-8	-40	-65	-726	65
	D	8	40	65	81	97	40	24	-32	-24	-24
	H	16	40	48	56	24	-169	-291	-323	-339	-387
16	V	0	8	0	-8	16	3882	6149	7368	8578	9765
	D	8	56	97	65	32	4269	6529	7779	8974	10144
	H	8	56	73	153	129	1436	2292	2720	3147	3607
17	V	0	0	-24	0	-40	3486	5278	6287	7207	8078
	D	56	73	113	113	525	4503	6480	7537	8554	9619
	H	48	105	153	250	678	1098	1122	1154	1170	1227
18	V	-16	-32	-48	-65	226	1162	1235	1291	1364	1420
	D	8	81	105	210	742	1695	944	1816	1856	1937

Table 5.1-PSN1 Concrete Strains in Beam PSN1-O

STATION	APPLIED SHEAR (KN)	30.0	60.0	75.0	90.0	105.0	112.0	120.0	127.5	135.0	142.5
						SIDE B					
						Concrete Strains ($x10^6$)					
2		10	41	41	61	61	439	561	663	755	-143
3		31	82	112	133	306	490	592	653	653	714
4		51	122	163	224	714	928	1071	1153	1234	1418
5		82	163	214	316	765	918	1122	1224	1306	1408
6		102	275	510	704	918	1040	1255	1367	1510	1652
7		0	0	0	0	-51	-122	-133	-133	-194	-204
8		-41	-51	-71	-61	-194	-286	-357	-388	-428	-459
9		-10	-31	-20	10	571	1265	1622	1856	2091	2397
9A		-20	-20	10	0	71	122	163	204	194	224
	H	10	20	41	61	-20	-296	-337	-469	-551	-632
11	V	-10	-10	0	-10	204	5855	8160	9914	11750	13903
	D	31	31	41	71	632	6089	8313	9965	11679	13678
	H	10	71	92	102	490	2020	2744	3162	3611	4182
12	V	10	-10	0	-10	2122	8711	11516	13597	15790	91851
	D	20	51	71	102	2734	8537	11138	13005	14943	91229
	H	71	122	143	163	673	551	632	673	704	734
13	V	0	-20	-20	-31	3172	8803	11495	13433	15535	91453
	D	31	71	92	92	3152	8405	10863	12679	14504	91820
	H	51	112	214	347	449	520	602	643	704	745
14	V	-20	-31	-31	-31	20	20	20	41	41	41
	D	10	71	133	275	357	398	449	500	520	520
	H	10	20	31	41	-51	-194	-255	-286	-316	-377
15	V	-20	-20	-31	-31	-61	-41	-61	-71	-61	-61
	D	31	61	71	92	31	10	0	0	-10	-20
	H	0	20	31	41	-92	-204	-245	-275	-275	-326
16	V	-10	-20	-10	-10	877	6273	8894	10873	12923	15412
	D	31	51	82	82	3213	8456	10965	12770	14586	91361
	H	31	51	82	92	959	2132	2734	3131	3488	3947
17	V	0	-10	-20	-20	2785	7783	10231	12005	13923	91127
	D	31	61	82	122	2897	7324	9568	11138	12791	91351
	H	31	51	133	163	377	479	571	653	673	765
18	V	-20	-31	-31	-31	-10	-10	0	0	-10	-10
	D	20	61	102	214	418	469	561	643	704	745

Table 5.1-PSN2 Concrete Strains in Beam PSN2-WD

SIDE A

Concrete Strains ($\times 10^{6}$)

STATION	APPLIED SHEAR(KN)	30.0	60.0	75.0	90.0	97.5	105.0	112.5	120.0	135.0	150.0	165.0	180.0	195.0	202.5
2		48	56	121	97	97	121	161	194	387	541	710	863	993	1065
3		48	113	137	178	178	194	347	428	734	872	1033	1202	1404	1525
4		105	161	242	307	404	541	799	944	1130	1267	1461	1614	1792	1864
5		65	153	299	395	484	605	791	839	1114	1275	1420	1695	1913	2009
6		89	274	428	484	621	726	815	847	1073	1251	1372	1541	1703	1775
7		-24	-32	-16	-8	-32	-40	-40	-81	-113	-97	-153	-178	-186	-202
8		16	16	0	16	8	16	-48	-89	-81	-105	-137	-194	-218	-258
9		0	-16	16	8	24	0	105	234	629	985	1356	1695	2098	2324
9A		-32	8	-16	24	186	315	508	516	557	508	492	484	516	492
10		97	234	355	557	662	734	880	960	1106	1307	1469	1662	1832	1905
	H	-32	-8	0	16	48	16	24	16	73	299	581	783	1017	1089
11	V	16	8	-8	32	16	0	16	161	1219	1856	3406	3333	4309	4939
	D	48	56	65	73	97	97	194	492	1832	2574	3494	4334	5367	6214
	H	73	81	105	121	178	137	379	638	1202	1428	1751	2017	2373	2655
12	V	16	16	0	0	0	32	476	976	2268	3050	3979	4963	6303	7174
	D	40	48	97	97	169	339	1154	1792	3365	4406	5609	6803	8361	9353
	H	73	113	153	194	250	500	726	783	888	944	1033	1122	1219	1235
13	V	-16	-40	-32	-40	32	299	1170	1614	2090	1896	1670	1654	1695	1719
	D	56	73	137	178	323	742	1816	2397	2655	2574	2558	2671	2792	2865
	H	48	137	202	258	581	638	662	742	855	936	1057	1154	1243	1340
14	V	-16	-8	-16	8	266	468	500	533	565	597	638	694	783	823
	D	56	121	178	274	718	839	888	928	1057	1098	1202	1356	1469	1533
	H	32	48	40	65	65	81	32	-16	-73	-129	-161	-202	-266	-315
15	V	0	0	8	0	0	8	8	-8	444	1106	1832	2486	3276	3680
	D	16	40	56	81	97	129	113	73	65	379	815	1138	1493	1670
	H	24	40	65	81	56	24	-40	-56	242	855	1662	2260	2905	3333
16	V	8	-8	0	-8	8	-8	508	807	2058	2929	3954	4931	6254	7126
	D	32	40	81	97	81	56	226	646	2042	3107	4374	5536	7005	7941
	H	16	56	81	105	65	178	726	1001	1396	1259	1057	1009	920	904
17	V	0	-32	-8	-8	-8	242	1017	1388	2243	2962	3769	4584	5641	6359
	D	32	81	97	89	81	347	1323	1808	2921	3857	4882	5891	7110	7933
	H	40	97	121	194	468	621	638	605	662	670	734	799	872	896
18	V	0	-8	-24	-40	161	291	573	654	742	783	799	847	888	920
	D	40	48	40	8	379	629	807	807	880	888	920	976	1033	1073

Table 5.1-PSN2 Concrete Strains in Beam PSN2-WD

SIDE B

Concrete Strains ($\times 10^6$)

STATION	APPLIED SHEAR (KN)	30.0	60.0	75.0	90.0	97.5	105.0	112.5	120.0	135.0	150.0	165.0	180.0	195.0	202.5
2		20	41	71	61	71	71	102	112	204	286	388	510	612	673
3		31	71	102	122	143	153	398	500	816	1000	1234	1469	1785	2009
4		61	133	163	235	316	479	663	755	938	1071	1193	1336	1673	1601
5		71	143	194	275	428	816	928	1214	1275	1520	1652	1867	2081	2162
6		143	275	469	704	826	959	1061	1204	1397	1571	2101	1989	2142	2254
7		-20	-41	-20	-41	-51	-71	-82	-82	-122	-153	-173	-255	-306	-337
8		-10	-31	-31	-41	-31	-61	-102	-92	-122	-153	-173	153	592	806
9		-10	-31	-20	-10	-10	71	337	439	806	1102	1428	1530	1438	1459
9A		-10	-10	-10	20	92	265	306	316	367	388	388	398	418	428
	H	20	41	31	51	61	61	-10	-51	275	592	989	1520	2020	2346
11	V	10	0	-10	-10	-10	0	133	306	1316	887	2856	4274	6059	7222
	D	31	31	61	71	92	102	439	734	1979	2601	3601	5090	6824	7956
	H	31	61	92	112	133	306	836	1040	1367	1479	1601	1652	1642	1714
12	V	0	0	-20	-31	-31	82	928	1285	2570	3346	4590	6477	8609	10057
	D	41	71	82	92	102	500	1581	1979	3488	4386	4835	4814	4763	4937
	H	61	102	133	133	245	479	490	510	612	683	755	847	938	979
13	V	0	-20	-31	-31	41	683	1632	2009	2315	2285	2244	2254	2407	2509
	D	41	61	92	92	245	1163	2101	2417	2662	2795	2897	3029	3274	3427
	H	133	204	265	306	490	551	612	673	806	887	1010	1112	1204	1295
14	V	-20	-41	-41	-41	133	204	214	235	296	357	428	490	561	612
	D	71	102	143	286	561	632	683	734	887	1040	1173	1326	1489	1591
	H	10	20	51	31	31	0	-61	-82	-133	-173	-286	-377	-449	-490
15	V	10	10	10	0	41	51	20	0	867	1632	2570	4172	6222	7466
	D	0	31	41	51	82	82	20	20	418	918	1887	3682	5794	7007
	H	10	61	51	51	41	-10	-71	-71	337	877	1540	2264	2825	3193
16	V	0	0	-20	-20	0	367	1255	1816	2927	3713	4804	6599	8650	10057
	D	51	82	82	112	102	337	1408	1826	3233	4141	5375	7120	9068	10384
	H	31	41	61	71	61	469	949	1173	1377	1275	1183	1091	1091	1102
17	V	0	-10	-31	-31	41	663	1438	1805	2774	3458	4366	5018	5294	5692
	D	41	61	92	112	153	908	1918	2213	3437	4315	5467	5661	5610	5865
	H	20	71	92	133	326	418	449	449	530	612	683	745	796	857
18	V	0	0	-31	-61	71	275	316	347	398	449	510	571	643	683
	D	41	71	102	153	367	622	653	694	796	898	989	1112	1244	1326

Table 5.1-PSN3 Concrete Strains in BEAM PSN3-D2

SIDE A

Concrete Strains ($\times 10^{6}$)

STATION	APPLIED SHEAR(KN)	30.0	60.0	75.0	90.0	97.5	105.0	112.5	120.0	135.0	150.0	165.0	180.0	195.0	210.0
2		48	73	97	137	113	153	169	242	339	404	492	629	751	1009
3		40	121	178	194	210	226	355	638	855	1033	1267	1453	1735	1937
4		89	153	202	242	266	492	557	815	888	1033	1146	1283	1469	1662
5		105	323	460	613	742	1089	1186	1380	1606	1816	2034	2211	2413	2582
6		97	299	371	613	767	880	1001	1138	1348	1566	1775	1985	2227	2453
7		8	0	16	48	32	16	-48	-56	-97	-121	-145	-161	-202	-242
8		-8	0	0	-40	-16	-65	-56	-97	-137	-161	-202	-250	-299	-363
9		-16	0	8	56	56	307	444	888	1146	1412	1719	2098	2518	2978
9A		8	0	24	56	113	113	89	121	145	202	242	1098	347	379
10		161	331	452	718	920	1017	1081	1267	1420	1646	1856	2009	2203	2461
	H	48	73	89	97	145	153	121	178	250	323	282	1114	1735	2365
11	V	0	-32	-24	-32	-32	-16	-16	444	1025	1533	2235	3155	4358	5859
	D	16	40	73	105	113	137	169	952	1646	2252	3188	4382	5875	7610
	H	56	105	145	169	178	169	202	742	1049	1332	1501	1541	1549	1606
12	V	16	0	8	0	-16	73	315	1638	2421	3220	4083	5714	7449	9410
	D	40	56	89	129	186	541	936	2437	3389	4334	5576	7102	8982	11064
	H	16	105	105	234	339	775	993	1081	1211	1323	1453	1566	1695	1840
13	V	-8	-24	-32	-24	0	565	920	1138	1211	1404	1695	1985	2308	2639
	D	40	97	145	202	323	1202	1695	1880	2050	2340	2679	3010	3357	3704
	H	48	137	226	250	291	371	395	428	476	549	613	662	742	863
14	V	-16	-32	-48	0	0	8	8	0	24	40	73	89	137	178
	D	56	89	89	161	218	242	258	291	339	420	476	541	654	751
	H	16	40	56	89	73	65	48	-32	-89	-113	-121	-226	-307	-331
15	V	0	0	-16	-8	0	8	8	565	1001	1372	2122	3196	4616	6101
	D	24	97	105	121	129	137	145	89	161	242	1009	2268	3979	5480
	H	32	56	73	73	97	40	24	597	1017	1348	1759	2219	2808	3438
16	V	8	8	8	0	8	-48	-24	1283	2034	2776	3809	5100	6763	8562
	D	48	105	113	153	153	145	145	1509	2340	3147	4180	5504	7110	8901
	H	24	56	113	161	161	662	880	904	920	1041	1106	1178	1267	1372
17	V	-8	-8	-8	-8	56	734	1089	2050	2695	3462	4439	5681	7118	8764
	D	65	121	137	202	274	1138	1533	2776	3615	4503	5649	7005	8635	10370
	H	56	121	169	266	315	291	299	331	371	371	404	428	460	492
18	V	8	-24	-24	-56	-56	-32	-24	-16	-32	-40	-40	-32	-8	8
	D	48	81	129	242	331	323	331	323	371	404	436	476	525	565

Table 5.1-PSN3 Concrete Strains in Beam PSN3-D2

SIDE B

Concrete Strains (x10[6])

STATION	APPLIED SHEAR (KN)	30.0	60.0	75.0	90.0	97.5	105.0	112.5	120.0	135.0	150.0	165.0	180.0	195.0	210.0
2		10	51	82	92	112	133	122	133	173	235	449	673	887	1122
3		31	41	61	153	184	224	255	367	918	1061	1122	1357	1520	1663
4		10	41	92	143	265	296	449	500	724	704	847	1020	1142	1173
5		82	255	357	490	683	745	1122	1316	1357	1734	1856	2091	2387	2652
6		112	235	337	418	653	755	1010	1275	326	1561	1754	2030	2101	2479
7		-20	-51	-41	-20	-51	0	-41	-20	-71	-143	-133	-173	-204	-326
8		-20	-20	-102	-82	-41	-20	-31	-31	275	439	663	928	1193	1530
9		-31	-61	-51	-20	-41	10	224	388	520	581	663	694	694	724
9A		-10	-10	-10	0	61	112	245	255	224	316	663	367	428	459
	H	20	10	41	10	-10	-31	20	-10	143	326	887	1336	1907	2346
11	V	-10	-41	-31	-31	-51	-31	-31	10	877	1408	2234	3376	4896	6763
	D	20	51	61	31	92	82	122	235	1469	1765	3172	4519	6232	8446
	H	0	51	51	61	41	133	112	194	704	806	785	755	734	755
12	V	51	31	0	0	10	10	51	286	1877	2693	3835	5447	7487	10027
	D	20	51	71	71	92	112	245	602	2377	3284	4519	6161	8119	10516
	H	31	51	82	204	173	245	663	969	1081	1234	1367	1632	1724	1958
13	V	-20	-20	-20	-10	-10	-10	337	796	1030	1153	1265	1448	1601	1805
	D	112	92	143	143	194	245	816	1428	1622	1826	2091	2356	2611	2907
	H	10	82	194	224	449	683	704	765	836	1061	1132	1224	1367	1540
14	V	31	-20	10	10	31	82	92	82	82	92	92	82	82	102
	D	61	92	92	82	286	388	1183	1387	1561	1775	2050	2377	2672	2978
	H	-10	10	0	-51	-10	31	-20	0	-112	-153	-173	-224	-326	-357
15	V	41	20	20	31	51	51	51	82	377	959	1816	3091	4488	6049
	D	0	31	61	82	82	82	102	61	41	347	1550	2968	4549	6293
	H	-20	-20	31	61	61	41	0	0	653	969	1377	1816	2244	2785
16	V	10	0	-10	0	20	20	10	-20	1316	1673	3152	4610	6569	8792
	D	31	51	61	71	92	92	92	71	1571	2366	3407	4988	6599	8670
	H	-10	0	10	102	143	133	541	847	979	1061	1183	1224	1377	1499
17	V	20	-31	0	-41	-20	-20	490	918	1244	1479	1765	2050	2305	2591
	D	20	51	82	71	82	112	755	1306	2652	3519	4702	6049	7834	9894
	H	51	61	41	102	326	306	377	357	377	398	459	428	449	561
18	V	-31	-31	20	-31	20	51	82	82	102	61	102	143	173	194
	D	10	41	82	92	224	316	347	347	357	388	449	459	490	520

Table 5.1-PSN4 Concrete Strains in Beam PSN4-WDH

SIDE A

Concrete Strains ($\times 10^6$)

STATION	APPLIED SHEAR (KN)	30.0	60.0	75.0	90.0	97.5	105.0	112.5	120.0	135.0	150.0	165.0	180.0	195.0	202.5
2		24	48	113	97	121	145	145	250	315	395	500	605	751	847
3		24	105	169	169	169	274	395	710	823	993	1146	1364	1622	1751
4		65	169	210	210	250	266	589	702	831	1025	1235	1356	1558	1695
5		81	169	226	315	395	670	976	1089	1283	1428	1558	1711	1905	1993
6		24	121	282	363	460	573	573	662	872	218	1243	1420	1574	1719
7		16	-24	-16	16	24	-8	-24	-48	-81	-129	-129	-186	-242	-258
8		-24	-40	-16	-8	0	8	-24	-81	-89	-137	-218	-242	-307	-371
9		-16	-8	-16	0	16	234	476	767	1162	1445	1687	2017	2461	2768
9A		8	24	8	24	73	161	137	97	145	194	274	355	412	436
10		169	347	387	436	516	549	678	742	920	1243	1501	1687	1913	2074
	H	40	65	97	113	121	121	137	533	993	1420	1872	2389	3139	3615
11	V	0	0	-16	-16	-8	8	32	928	1792	2623	3607	4576	6238	7368
	D	48	89	97	105	129	137	194	1332	2292	3212	4301	5415	7198	8393
	H	40	81	129	161	210	145	468	629	662	751	775	815	799	807
12	V	-8	-8	-16	-16	-16	-8	565	1888	3002	4108	5358	6690	8788	10144
	D	24	73	105	121	137	153	880	2300	3510	4697	6053	7424	9595	11016
	H	32	129	161	194	210	331	694	670	702	791	888	944	1057	1114
13	V	-24	-16	-32	-24	-32	89	1170	2332	2695	2752	2873	3067	3381	3551
	D	32	105	97	202	315	638	2009	3309	3333	3373	3502	3736	3954	4051
	H	105	186	307	363	525	702	678	710	759	863	904	968	1057	1081
14	V	-8	-24	-8	-24	-8	32	16	0	8	16	48	105	178	210
	D	65	121	186	331	428	646	613	605	629	702	839	976	1162	1283
	H	16	48	89	81	97	97	16	-48	-113	-145	-194	-250	-331	-355
15	V	0	32	16	8	16	40	32	1267	2268	3260	4382	5544	7376	8627
	D	16	65	65	113	121	137	888	1194	2445	3478	4729	6044	7997	9305
	H	32	65	89	113	113	56	16	0	412	1041	2421	2962	3704	3422
16	V	-24	-8	-16	-16	-32	8	662	1913	3042	4132	5334	6609	8595	9894
	D	-16	40	65	65	65	89	452	1848	3091	4269	5504	6803	8748	10047
	H	40	81	73	129	129	412	976	1517	1574	1453	1348	1307	1219	1162
17	V	0	0	0	0	-24	226	1227	2147	3050	3987	5011	6085	7731	8829
	D	32	105	105	129	186	654	1719	2816	3898	5011	6174	7368	9176	10322
	H	40	113	153	202	266	258	242	250	299	387	613	742	896	960
18	V	-16	-8	0	-32	0	97	97	97	97	73	65	81	8	8
	D	32	73	113	137	210	371	299	274	274	476	767	944	1170	1291

Table 5.1-PSN4 Concrete Strains in Beam PSN4-WDH

SIDE B

Concrete Strains (x10⁶)

STATION	APPLIED SHEAR(KN)	30.0	60.0	75.0	90.0	97.5	105.0	112.5	120.0	135.0	150.0	165.0	180.0	195.0	202.5
2		-10	41	82	82	92	92	102	122	428	571	612	612	581	551
3		51	71	153	204	184	224	204	275	632	734	877	1234	1561	1816
4		31	133	153	265	275	377	602	796	969	1061	1204	1285	1469	1612
5		61	173	224	316	347	428	612	683	898	1132	1265	1428	1714	1775
6		92	163	316	469	500	704	816	959	1071	1285	1571	1652	1897	2040
7		0	0	0	20	31	51	51	51	-10	-20	-82	-92	-143	-122
8		-20	-51	-31	-41	-61	-51	-20	-61	-133	-153	-204	-245	-275	-347
9		-20	0	-20	-10	-20	10	204	388	979	1275	1663	1979	2387	2621
9A		31	10	-31	20	61	61	61	61	51	41	71	102	184	194
11	H	0	0	173	153	122	163	204	204	204	204	214	469	673	734
	V	0	-10	10	10	-31	0	-20	0	1561	2366	3315	4141	5528	5345
	D	10	51	71	82	71	71	122	153	1918	2805	3805	4753	6324	7313
12	H	0	51	92	122	153	61	122	194	1112	1499	1765	1846	2407	2672
	V	-10	0	-20	-31	-51	-31	-20	326	2570	3641	4906	6324	8384	9721
	D	41	41	31	61	102	122	153	663	3019	4121	5477	6865	8833	10118
13	H	20	51	143	194	163	133	530	908	1051	1112	1255	1306	1448	1540
	V	-41	-31	-31	-51	-31	-51	643	1081	1112	1418	1724	1724	1724	1754
	D	41	82	112	122	184	214	734	1601	3907	5222	6610	8048	10067	11383
14	H	31	61	224	337	408	602	622	673	734	826	989	1071	1122	1142
	V	41	-10	20	20	0	-61	-92	-92	-51	-82	-82	-61	-61	-51
	D	71	102	194	306	418	653	1275	1448	1734	1795	1907	1979	2122	2193
15	H	-51	-51	31	-10	31	20	10	-20	-102	-153	-224	-286	-316	-367
	V	41	31	61	71	51	41	41	31	71	92	581	1132	1795	2234
	D	31	51	71	102	112	112	122	102	61	51	61	102	235	388
16	H	-20	-71	41	71	71	31	10	-20	326	989	1510	2122	2734	3152
	V	-10	-20	-20	-31	0	0	-71	-102	2856	3029	4284	5671	7599	8874
	D	51	71	92	112	143	163	92	133	235	2948	4264	5671	7517	8762
17	H	31	71	92	112	163	214	622	1020	1163	1357	1367	1387	1336	1306
	V	20	0	31	20	20	-20	388	1020	2550	3478	4488	5579	7109	8119
	D	20	61	71	92	122	388	969	1714	3580	4753	5885	7171	8782	9914
18	H	82	122	153	255	204	133	122	82	31	102	133	194	122	102
	V	20	-20	10	41	-10	41	-71	-41	-51	-51	-20	-10	-10	-82
	D	41	61	92	122	143	255	663	1153	2009	2050	1948	1907	1897	1958

Table 5.1-PSN5 Concrete Strains in Beam PSN5-S6M

STATION	APPLIED SHEAR (KN)	30.0	60.0	75.0	90.0	97.5	105.0	120.0	135.0	150.0	165.0	180.0	195.0	210.0
							SIDE A							
							Concrete Strains ($\times 10^6$)							
2		16	48	105	97	121	121	145	307	404	646	847	1057	1251
3		48	81	121	137	145	161	492	791	863	1009	1138	1332	1493
4		81	169	218	250	266	323	670	872	1106	1404	1493	1662	1872
5		73	186	339	484	565	718	1114	1428	1541	1816	1921	2114	2389
6		137	282	460	605	718	960	1162	1445	1646	1824	2009	2962	2429
7		-24	-16	-16	-40	-16	791	-65	-89	-169	-153	-178	-226	-242
8		0	0	0	-32	-32	-32	-65	-89	-169	-186	-242	-274	-299
9		-24	-16	0	-8	0	24	282	646	73	1235	1574	1993	2421
9A		0	-16	-32	-32	0	145	307	412	444	525	565	654	718
10		153	274	347	549	662	759	896	1138	1299	1509	1670	1864	2074
	H	16	0	56	73	97	73	24	137	81	-178	-315	-573	-823
11	V	8	-8	-24	0	-8	-8	16	823	1469	2590	3494	4414	5375
	D	24	40	56	73	-726	81	250	1388	2187	3631	4858	6295	7901
	H	8	73	129	129	137	202	16	541	1751	1614	2171	3172	4519
12	V	-16	-40	-24	-32	-40	-40	912	1566	3430	5100	6787	8829	10919
	D	48	81	97	129	153	161	1493	3268	4535	5722	8457	10798	13049
	H	48	97	178	218	250	266	985	1098	1267	1549	1832	1961	1590
13	V	-8	0	0	0	-8	8	1485	3002	4116	5818	7392	9240	11201
	D	48	97	145	186	218	331	2155	3946	5221	7174	9014	11169	13848
	H	65	161	218	242	282	581	904	1073	1202	1404	1525	1687	1856
14	V	-16	-32	-40	-40	-24	113	452	549	646	8	944	1114	1251
	D	8	65	105	129	186	597	1001	1202	1396	1654	1856	2074	2300
	H	0	48	40	48	48	65	8	-56	-113	-169	-274	-307	-404
15	V	16	8	8	0	0	0	8	500	888	872	863	839	823
	D	32	73	89	113	129	121	97	89	145	153	113	81	48
	H	8	48	73	81	81	81	-65	-73	-145	-161	-226	-250	-323
16	V	-16	-16	-8	-24	-16	0	-73	1194	1888	2937	3874	5165	6948
	D	48	65	89	89	113	137	1590	3325	4519	6416	8191	10281	484
	H	16	73	113	137	178	129	702	1348	1767	2421	3050	3809	4664
17	V	8	-8	-8	8	-16	-8	1081	2316	3220	4568	5891	7336	8933
	D	56	81	113	113	129	145	1662	3099	4100	5609	6989	8643	10435
	H	40	89	121	178	186	436	678	799	944	1081	1186	1291	1388
18	V	-8	-32	-48	-56	-81	73	444	589	726	912	1065	1235	1396
	D	32	65	97	121	105	404	823	1017	1194	1420	1606	1816	2009

Table 5.1-PSN5 Concrete Strains in Beam PSN5-S6M

SIDE B

Concrete Strains (x10⁶)

STATION	APPLIED SHEAR (KN)	30.0	60.0	75.0	90.0	97.5	105.0	120.0	135.0	150.0	165.0	180.0	195.0	210.0
2		61	71	71	102	102	102	112	153	255	347	530	602	826
3		51	92	92	133	133	143	173	520	816	969	1183	1377	1581
4		61	143	204	265	347	418	673	184	1387	1591	1836	1765	2346
5		20	153	214	265	326	408	714	928	1142	1306	1499	1693	1897
6		153	296	408	592	724	989	71	367	1550	1785	1989	2193	2448
7		10	0	0	0	-10	-10	-61	-92	-122	-153	-194	-235	-326
8		0	-10	0	-10	-31	-20	-41	-112	-163	-224	-377	-306	-377
9		10	0	10	0	10	20	-10	296	694	1091	1499	1969	2468
9A		0	0	10	10	41	82	337	632	561	1571	530	490	469
	H	10	41	31	10	61	71	71	-92	908	-133	520	-245	-388
11	V	20	41	20	20	31	31	20	592	1816	2866	4264	541	7058
	D	-31	10	-31	20	31	41	20	1020	2387	3662	5100	6661	8303
	H	10	61	82	112	122	122	92	979	1591	2132	2713	3499	4121
12	V	-20	-20	-20	-10	-10	-20	61	1918	3386	4906	6508	8344	10333
	D	10	41	51	61	92	31	367	2611	4223	5885	7619	9639	11699
	H	41	92	143	184	194	245	-418	908	979	1112	2091	1326	1459
13	V	-20	-20	-20	-20	-10	20	1408	1591	1622	2030	1765	1877	1000
	D	0	51	82	122	173	235	1030	2632	4396	6059	7834	9466	11036
	H	41	122	163	255	275	347	551	612	683	745	826	898	989
14	V	-31	-71	-71	-61	-41	10	592	898	959	1020	1071	1122	1193
	D	10	51	82	153	214	347	1244	1377	1561	1581	1683	1785	1907
	H	41	51	61	71	0	82	0	-51	-153	-184	-367	-326	-398
15	V	0	-10	-10	-20	-10	-20	0	20	-163	-306	-592	-694	-694
	D	20	61	82	92	92	112	102	51	245	520	1306	3886	5855
	H	31	41	71	71	92	71	31	214	969	1550	2203	3029	3692
16	V	0	-10	-10	-10	-10	0	-10	592	1989	4406	6956	7609	9262
	D	10	31	61	71	61	71	61	1540	4151	5753	7477	9374	11414
	H	0	41	51	82	102	112	20	704	581	581	500	459	1459
17	V	71	92	61	61	71	71	479	1091	2224	4427	602	7079	8619
	D	10	51	82	112	122	153	1051	3070	4427	5834	7283	8894	10669
	H	61	112	143	184	255	388	918	949	959	979	1000	1010	1040
18	V	-31	-41	-51	-51	-82	-92	194	704	796	857	1897	908	949
	D	10	41	61	92	184	326	928	1346	1387	1448	1469	1520	1581

Table 5.1-PSN6 Concrete Strains in Beam PSN6-WS

		SIDE A													
STATION	APPLIED SHEAR (KN)	30.0	60.0	75.0	90.0	97.5	105.0	112.5	120.0	135.0	150.0	165.0	180.0	195.0	210.0
		Concrete Strains ($x10^6$)													
2		32	81	97	113	129	129	153	202	299	420	597	791	976	1170
3		48	105	137	202	218	234	250	420	686	734	880	1041	1202	1364
4		129	178	250	355	460	533	646	968	1146	1323	1533	1743	1888	2122
5		24	194	250	331	412	541	702	815	960	1130	1259	1404	1509	1614
6		97	291	444	573	726	823	920	1041	1202	1356	1549	1679	1848	2042
7		-24	-8	-8	-16	-8	0	8	-16	-8	-81	-105	-113	-137	-178
8		8	-24	-16	-8	-32	-24	-8	-32	-137	-129	-169	-202	-210	-250
9		-32	16	-8	-8	0	16	24	40	274	468	734	1057	1323	1598
9A		-16	0	8	-16	16	81	194	452	573	597	646	702	726	791
10		89	291	444	597	710	807	888	976	1211	1380	1541	1695	1896	2026
	H	56	65	56	73	105	81	97	16	16	-56	-113	-234	-323	-452
11	V	16	0	0	-8	8	0	16	65	331	872	1291	1751	2058	2389
	D	56	81	89	105	137	169	194	387	791	1477	2017	2728	3317	3970
	H	40	81	73	153	137	153	129	89	8	-8	395	1259	2090	2962
12	V	-8	-16	-24	-16	-16	-8	32	-202	1436	2219	3026	4043	4979	6101
	D	32	73	97	129	161	194	379	1299	2445	3583	4786	6270	7812	9442
	H	16	97	129	169	194	186	145	573	1170	1711	1824	1719	2389	1477
13	V	-48	-65	-65	-56	-48	-16	210	1073	2074	3034	3970	5173	6416	7715
	D	32	97	105	145	161	250	678	1759	3026	4196	5399	6981	8498	10136
	H	73	210	250	274	266	420	767	968	1106	1235	1380	1517	1646	1783
14	V	-16	-32	-32	-24	0	186	428	888	1017	1098	1194	1340	1493	1670
	D	73	121	161	266	315	621	1025	1533	1695	1896	2098	2373	2647	2921
	H	32	40	40	56	56	48	56	16	-24	-24	-73	-186	-202	-274
15	V	-8	-8	0	-16	0	8	8	8	8	0	-8	-8	0	-16
	D	65	105	105	153	169	186	178	210	210	194	186	161	194	161
	H	40	48	73	73	113	105	81	16	-40	-73	-97	-161	-194	-274
16	V	-24	-8	-32	-32	-16	0	-16	-32	-56	8	960	2050	3083	4188
	D	24	65	81	129	129	137	105	73	89	65	137	1211	2518	3946
	H	8	65	48	65	56	73	81	242	702	1170	1622	2171	2703	3284
17	V	0	0	-8	-8	0	-16	-56	387	1299	2082	2833	3785	4705	5730
	D	40	89	89	121	129	97	210	1202	2332	3341	4350	5601	6819	8102
	H	65	81	145	266	371	-210	40	1202	1267	1348	1461	1558	1622	1735
18	V	-8	-32	-40	-65	-65	-16	129	428	702	783	855	960	1057	1202
	D	105	145	194	339	460	662	952	1501	1711	1832	1969	2130	2316	2534

Table 5.1-PSN6 Concrete Strains in Beam PSN6-WS

SIDE B

Concrete Strains (x10^6)

STATION	APPLIED SHEAR (KN)	30.0	60.0	75.0	90.0	97.5	105.0	112.5	120.0	135.0	150.0	165.0	180.0	195.0	210.0
2		51	51	61	82	92	102	112	133	204	347	469	561	632	714
3		102	102	133	173	194	224	245	408	836	1020	1163	1326	1520	1754
4		143	143	214	265	306	367	459	806	836	1244	1448	1540	1877	2081
5		194	194	235	306	337	459	612	806	959	1112	1255	1397	1550	1703
6		255	255	367	479	490	673	734	847	1000	1153	1306	1469	1632	1795
7		-20	-20	-20	-31	-20	-10	-20	-41	-92	-122	-153	-173	-224	-265
8		-20	-20	-31	-41	-20	-10	-31	-71	-122	-153	-194	-255	-306	-459
9		-31	-31	-20	-31	-20	-20	31	408	806	1132	1459	1836	2244	2683
9A		-31	-31	-10	0	41	51	82	31	41	31	10	20	-20	0
	H	41	41	41	31	61	71	82	51	31	20	173	347	510	724
11	V	-20	-20	-10	-20	-20	-31	-10	0	928	2091	2856	3713	4692	6283
	D	51	51	71	82	102	112	112	265	1510	2764	3662	4692	5834	7466
	H	61	61	112	122	153	173	173	286	1183	1673	2009	2356	2713	3070
12	V	-20	-20	-20	-31	-31	-92	0	500	1999	3366	4417	5600	6987	8874
	D	82	82	92	112	143	163	184	1071	2795	4274	5498	6803	8293	10180
	H	122	122	173	194	224	235	245	734	724	775	836	908	979	1071
13	V	-10	-10	-10	-20	0	20	92	1173	2703	3509	3193	2856	2764	2570
	D	112	112	143	184	214	265	479	1846	3692	4253	3998	3876	3947	4070
	H	-10	-10	31	61	163	286	561	551	612	724	806	908	1020	1142
14	V	-31	-31	-51	-51	-31	10	194	173	153	133	133	143	153	153
	D	92	92	133	173	245	398	724	847	857	908	938	1061	1112	1234
	H	41	41	31	41	61	61	71	10	-82	-143	-204	-265	-326	-377
15	V	0	0	-10	0	0	10	10	10	-61	-184	20	275	643	908
	D	61	61	82	92	102	102	133	102	428	1989	3172	4478	5824	7609
	H	61	61	51	61	71	71	82	1020	938	887	857	1642	2295	3009
16	V	-20	-20	-20	0	-20	-10	0	235	1887	3213	4253	4447	6854	8599
	D	82	82	82	112	133	153	143	184	1969	3437	4661	4998	7466	9272
	H	82	82	92	112	112	112	92	765	1561	1938	1693	1469	1408	1346
17	V	-10	-10	-31	-20	-10	-20	0	949	2244	3244	4121	5120	6263	7650
	D	173	173	194	224	255	326	602	1836	3366	4580	5712	6936	8252	9812
	H	92	92	122	204	275	377	602	490	459	469	428	490	520	541
18	V	31	31	-20	-31	10	51	82	51	51	1081	61	1102	1102	102
	D	-82	-82	-41	51	143	214	408	1285	2285	2897	2958	2917	2825	2825

Table 5.2-PSN1 Principal Strains in Beam PSN1-0

STATION	APPLIED SHEAR(KN)	30.0	60.0	75.0	90.0	105.0	112.0	120.0	127.5	135.0	142.5
						SIDE A					
					Principal Strains (x10⁶)						
	e1	34	60	78	102	119	5102	7780	9256	10798	12301
11	e2	-17	-12	-30	-13	-31	-1471	-2050	-2461	-2728	-3004
	θ′	35.8	13.3	31.7	19.6	26.9	63.8	65.0	65.1	65.4	65.6
	e1	45	105	121	154	155	5800	7937	9989	11475	12955
12	e2	11	-25	-16	-41	-26	647	1698	1406	1695	1909
	θ′	22.5	14.9	20.1	24.2	31.7	65.1	70.8	66.0	66.2	66.3
	e1	54	128	149	231	557	6048	8637	10114	11536	12952
13	e2	-29	-47	-28	-13	-186	-738	-1221	-1479	-1706	-1977
	θ′	14.5	16.8	15.0	17.1	44.4	62.1	62.6	62.9	63.2	63.3
	e1	55	155	164	270	902	1753	1814	1869	1900	2022
14	e2	-47	-50	-35	-68	26	111	123	181	190	230
	θ′	22.5	5.7	7.0	16.7	26.6	52.3	50.2	50.0	49.8	49.8
	e1	17	45	65	84	97	62	50	6	15	98
15	e2	-9	-13	-33	-28	-49	-231	-316	-362	-1064	-397
	θ′	9.2	28.2	40.3	34.5	41.8	60.8	60.3	63.9	34.0	74.8
	e1	16	60	101	76	33	5007	7759	9259	10711	12140
16	e2	0	-12	-52	-27	7	-1294	-1900	-2214	-2471	-2763
	θ′	0.0	31.7	35.8	25.7	35.8	65.0	65.9	66.0	66.3	66.5
	e1	57	81	125	161	532	4746	6866	8023	9117	10231
17	e2	-49	-24	-77	-8	-443	177	704	983	1237	1454
	θ′	42.8	28.8	30.7	12.7	40.0	58.3	59.5	60.2	60.5	60.3
	e1	49	118	166	289	820	1696	1419	1820	1864	1944
18	e2	-17	-45	-61	-103	84	564	937	626	670	703
	θ′	7.0	16.5	13.7	18.3	26.1	46.6	51.8	48.3	49.7	49.5

Table 5.2-PSN1 Principal Strains in Beam PSN1-0

STATION	APPLIED SHEAR(KN)	30.0	60.0	75.0	90.0	105.0	112.0	120.0	127.5	135.0	142.5
						SIDE B					
					Principal Strains ($\times 10^6$)						
	e1	32	35	49	84	644	7298	10029	12101	14248	16755
11	e2	-32	-25	-8	-33	-460	-1739	-2205	-2656	-3048	-3485
	θ	35.8	29.5	22.5	26.1	50.9	66.4	67.0	67.4	67.7	67.9
	e1	20	76	98	125	2950	9976	13072	15352	17736	109569
12	e2	0	-15	-7	-33	-339	755	1188	1407	1665	-13536
	θ′	45.0	13.3	14.5	22.5	59.9	68.3	68.8	69.2	69.6	67.7
	e1	72	125	148	166	3675	10237	13312	15559	17905	110502
13	e2	-0	-23	-26	-34	170	-884	-1184	-1453	-1666	-18314
	θ′	4.1	8.0	10.3	7.4	67.7	68.9	69.3	69.3	69.6	67.4
	e1	51	118	221	380	481	551	633	682	735	767
14	e2	-21	-37	-37	-64	-12	-10	-11	2	9	18
	θ′	4.1	11.6	9.2	15.9	14.9	13.5	12.7	13.9	12.0	10.0
	e1	34	65	78	99	31	31	27	30	31	35
15	e2	-44	-65	-78	-89	-143	-266	-344	-387	-408	-473
	θ′	33.4	35.8	33.4	33.8	43.3	60.5	60.8	60.5	62.8	64.2
	e1	31	55	84	86	3254	9349	12385	14621	16898	91730
16	e2	-41	-55	-64	-56	-2469	-3280	-3736	-4023	-4250	-76644
	θ′	40.9	34.1	37.0	34.5	49.9	60.4	62.3	63.4	64.3	47.7
	e1	37	71	103	139	3244	8643	11337	13263	15332	109341
17	e2	-6	-31	-42	-68	499	1272	1627	1874	2079	-14267
	θ′	22.5	26.6	22.5	28.5	65.8	70.0	70.3	70.6	71.0	67.4
	e1	35	76	147	243	488	574	682	781	837	911
18	e2	-25	-55	-45	-111	-121	-104	-111	-128	-174	-157
	θ′	15.5	25.7	16.0	28.4	25.2	21.9	22.0	22.0	23.7	21.7

Table 5.2-PSN2 Principal Strains in Beam PSN2-WD

SIDE A

Principal Strains ($\times 10^6$)

STATION	APPLIED SHEAR (KN)	30.0	60.0	75.0	90.0	97.5	105.0	112.5	120.0	135.0	150.0	165.0	180.0	195.0	202.5
11	e1	53	57	65	73	99	97	194	499	1963	2765	4054	4666	5828	6748
	e2	-70	-57	-73	-25	-34	-81	-153	-321	-672	-610	-68	-551	-502	-720
	θ′	56.6	49.1	43.3	49.7	38.0	42.4	44.3	50.1	57.9	58.7	66.6	59.6	60.7	60.5
12	e1	73	81	121	131	209	344	1156	1806	3450	4553	5826	7116	8815	9895
	e2	16	16	-16	-10	-31	-175	-300	-192	20	-74	-96	-135	-140	-66
	θ′	4.1	0.0	20.1	15.5	21.1	39.2	46.9	49.9	54.0	55.3	56.0	57.0	58.0	58.5
13	e1	81	121	181	231	353	757	1844	2467	2801	2669	2600	2699	2813	2886
	e2	-24	-49	-60	-78	-71	42	53	-70	177	172	104	78	100	68
	θ′	16.2	12.7	19.8	20.4	29.5	36.8	52.2	54.6	58.6	56.2	52.4	50.9	50.1	49.9
14	e1	68	157	231	322	758	852	898	946	1086	1138	1260	1413	1523	1602
	e2	-36	-27	-45	-56	90	254	264	329	334	395	435	435	502	561
	θ′	25.7	18.9	18.9	24.2	30.9	36.8	37.6	35.1	33.6	31.4	29.7	31.0	31.6	30.1
15	e1	32	53	60	90	104	137	114	73	471	1115	1832	2486	3276	3680
	e2	0	-5	-12	-26	-40	-48	-73	-97	-100	-139	-162	-202	-266	-315
	θ′	0.0	16.8	31.7	28.2	31.7	33.4	41.3	46.4	77.4	85.0	89.4	89.9	89.8	89.8
16	e1	34	50	90	111	86	59	509	885	2423	3489	4749	5951	7527	8538
	e2	-2	-18	-26	-39	-22	-43	-40	-134	-123	295	868	1239	1633	1920
	θ′	31.7	22.5	28.2	26.9	31.7	35.8	89.2	74.0	67.8	65.2	63.1	62.3	62.3	62.5
17	e1	34	94	111	118	92	351	1346	1838	3000	4054	5230	6370	7779	8725
	e2	-17	-70	-39	-21	-36	69	397	551	640	167	-404	-778	-1218	-1462
	θ′	35.8	28.5	26.9	17.8	27.7	51.6	53.9	53.8	55.5	58.0	59.4	60.0	60.8	61.2
18	e1	49	97	121	212	481	696	810	809	884	897	923	978	1033	1074
	e2	-8	-8	-25	-59	148	216	401	450	520	555	610	668	726	742
	θ′	22.5	2.2	3.2	15.2	11.4	23.2	40.5	48.9	51.4	54.6	50.9	49.5	46.5	47.1

Table 5.2-PSN2 Principal Strains in Beam PSN2-WD

SIDE B

STATION	APPLIED SHEAR(KN)	30.0	60.0	75.0	90.0	97.5	105.0	112.5	120.0	135.0	150.0	165.0	180.0	195.0	202.5
	Principal Strains (x10⁶)														
11	e1	31	43	65	80	101	108	445	760	2088	2607	3843	5486	7479	8785
	e2	-1	-2	-45	-39	-50	-47	-323	-505	-497	-1128	3	307	599	783
	θ′	35.8	13.3	34.1	29.5	30.8	33.4	50.4	53.2	56.9	47.3	59.5	61.1	63.0	63.8
12	e1	45	82	108	129	147	520	1583	1988	3603	4596	5389	6591	8628	10164
	e2	-14	-20	-37	-47	-45	-132	182	338	334	229	803	1539	1623	1607
	θ′	29.5	26.6	19.6	17.8	16.0	34.9	46.9	49.3	55.8	57.7	65.3	81.4	87.0	83.6
13	e1	63	105	142	142	287	1172	2248	2639	2934	3020	3083	3188	3435	3593
	e2	-2	-24	-40	-40	-1	-9	-126	-120	-7	-52	-84	-88	-89	-105
	θ′	9.2	9.2	13.3	13.3	22.5	50.0	59.4	61.5	62.7	60.7	59.0	57.7	57.3	57.2
14	e1	134	206	268	364	618	686	749	810	973	1117	1258	1411	1569	1677
	e2	-22	-42	-44	-99	4	69	78	98	129	127	180	190	196	230
	θ′	5.7	4.7	5.7	20.7	27.2	27.9	26.8	26.0	26.4	28.8	28.7	29.7	31.1	30.9
15	e1	20	31	53	54	82	87	37	33	870	1652	2753	4789	7311	8800
	e2	0	-1	8	-24	-10	-36	-78	-114	-135	-193	-468	-994	-1538	-1823
	θ′	45.0	35.8	13.3	33.4	48.2	57.2	67.5	61.8	87.1	84.1	76.2	70.9	69.5	69.3
16	e1	51	90	91	119	105	425	1643	2214	3692	4623	5914	7885	10161	11715
	e2	-41	-29	-60	-88	-64	-68	-460	-469	-428	-33	430	979	1314	1535
	θ′	41.8	29.5	30.8	34.9	38.0	70.0	64.5	67.3	64.5	63.8	63.3	64.4	65.6	66.2
17	e1	45	68	105	125	154	921	1958	2279	3606	4599	5902	6318	6396	6767
	e2	-14	-37	-74	-85	-52	211	429	699	545	133	-353	-208	-10	26
	θ′	29.5	30.5	29.5	30.5	42.1	52.9	54.3	56.8	58.6	59.6	60.3	63.5	65.5	66.5
18	e1	42	86	125	188	410	631	661	698	802	907	999	1120	1250	1333
	e2	-22	-15	-63	-116	-12	62	104	98	126	154	195	196	188	207
	θ′	35.8	22.5	24.7	25.2	26.4	37.7	38.1	40.1	39.3	38.7	38.8	39.6	40.9	40.6

Table 5.2-PSN3 Principal Strains in Beam PSN3-D2

SIDE A

Principal Strains ($\times 10^6$)

STATION	APPLIED SHEAR (KN)	30.0	60.0	75.0	90.0	97.5	105.0	112.5	120.0	135.0	150.0	165.0	180.0	195.0	210.0
	e1	50	76	102	129	162	178	188	966	1718	1915	3307	4747	6602	9029
11	e2	-1	-36	-37	-65	-49	-40	-83	-345	-443	-181	-186	-35	201	80
	θ′	9.2	10.5	17.8	24.2	16.2	19.5	29.8	50.9	55.5	60.5	56.3	57.6	58.9	59.8
	e1	57	105	146	180	223	543	938	2515	3526	3551	4994	6957	9352	12302
12	e2	16	-0	7	-11	-62	-301	-422	-134	-56	-53	-373	-755	-1130	-1520
	θ′	5.7	2.2	5.0	13.8	23.6	41.7	47.4	54.9	56.3	60.8	62.3	63.7	65.1	66.1
	e1	42	126	165	266	398	1213	1696	1881	2050	1827	2093	2361	2613	2910
13	e2	-34	-45	-92	-56	-59	127	217	338	371	560	539	719	712	854
	θ′	35.8	20.6	28.9	18.4	21.1	39.4	43.6	46.0	45.0	43.2	43.1	41.8	43.2	42.9
	e1	68	145	226	255	308	379	403	441	493	1869	2141	2469	2776	3095
14	e2	-36	-40	-48	-5	-17	1	0	-13	7	-716	-917	-1163	-1327	-1453
	θ′	25.7	11.6	0.0	8.1	13.3	8.1	8.1	9.9	10.7	34.0	35.1	35.8	35.9	35.8
	e1	26	99	112	134	136	141	147	614	1075	962	2054	3692	5529	7552
15	e2	-10	-59	-72	-54	-63	-68	-90	-81	-163	-156	-412	-826	-1367	-1860
	θ′	31.7	37.6	33.4	29.5	34.3	37.2	40.1	74.6	75.8	87.1	71.9	68.6	67.1	66.4
	e1	51	109	120	159	163	152	147	1604	2486	2424	3711	5472	7486	9951
16	e2	-11	-44	-39	-86	-58	-160	-147	276	565	218	818	954	1327	1626
	θ′	33.4	35.8	33.0	36.4	33.1	36.7	40.3	60.5	61.0	54.3	63.9	64.1	67.3	68.1
	e1	67	126	157	228	282	1139	1543	2897	3822	3529	4715	6068	7852	9913
17	e2	-51	-78	-52	-74	-65	257	426	57	-206	-989	-1767	-2794	-4169	-5823
	θ′	37.0	35.8	27.2	27.9	36.2	47.4	50.4	56.9	58.1	47.7	47.6	47.7	47.2	47.0
	e1	61	128	185	317	403	381	389	397	455	460	526	510	537	610
18	e2	3	-31	-39	-107	-145	-123	-115	-82	-116	-1	35	61	86	145
	θ′	16.8	12.0	15.1	20.2	23.7	25.1	25.1	21.8	22.5	21.6	21.7	25.3	26.2	18.9

Table 5.2-PSN3 Principal Strains in Beam PSN3-D2

SIDE B

STATION	APPLIED SHEAR(KN)	30.0	60.0	75.0	90.0	97.5	105.0	112.5	120.0	135.0	150.0	165.0	180.0	195.0	210.0
		Principal Strains ($\times 10^{-6}$)													
11	e1	27	56	72	35	93	82	125	235	1537	2383	3421	4603	6164	8022
	e2	-17	-86	-61	-56	-155	-143	-135	-235	-517	-527	-903	-334	-71	201
	θ′	22.5	34.5	28.8	31.7	40.3	45.0	39.3	46.2	55.5	57.3	58.4	57.2	57.4	58.3
12	e1	52	55	78	82	94	145	248	605	2525	4540	5861	7680	9865	12297
	e2	-1	26	-27	-20	-43	-2	-84	-125	56	12	-277	-425	-867	-1282
	θ′	84.3	22.5	30.5	26.6	38.5	16.8	39.7	48.6	59.2	57.3	57.4	60.5	61.7	62.5
13	e1	115	100	154	213	227	298	856	1435	1622	2341	2686	3028	3391	3758
	e2	-105	-69	-93	-20	-63	-63	144	330	489	387	461	523	611	721
	θ′	38.3	32.5	32.8	11.6	25.4	22.5	31.4	40.5	43.7	46.2	48.1	49.8	51.4	52.6
14	e1	62	110	194	230	454	683	1241	1446	1623	578	644	706	810	933
	e2	-22	-49	10	4	26	82	-445	-599	-705	11	42	44	69	108
	θ′	52.0	25.1	3.2	9.2	6.2	0.5	34.4	35.2	35.5	13.1	13.1	15.0	17.6	16.9
15	e1	45	31	62	90	89	83	109	86	394	1467	2122	3366	5218	7017
	e2	-14	-1	-42	-111	-48	-1	-78	-5	-129	-208	-121	-397	-909	-1247
	θ′	74.5	54.2	50.7	57.0	58.3	52.0	56.2	76.7	79.7	76.2	89.8	77.7	71.7	70.6
16	e1	34	52	65	82	96	93	92	72	1658	3361	4516	6000	7837	9871
	e2	-44	-72	-45	-20	-14	-31	-82	-92	311	763	1052	1320	1734	2129
	θ′	56.6	49.7	34.1	26.6	34.1	40.3	46.7	41.4	59.7	61.7	63.1	64.0	65.2	65.7
17	e1	27	53	82	113	145	151	756	1307	2658	4808	6097	7655	9512	11531
	e2	-17	-83	-72	-52	-23	-39	274	457	-434	-305	-553	-795	-1127	-1395
	θ′	67.5	38.5	43.1	14.9	7.0	18.1	42.0	47.4	47.5	59.1	60.0	61.1	61.7	62.4
18	e1	51	68	83	123	335	366	418	407	421	480	519	559	605	647
	e2	-31	-37	-21	-51	12	-9	41	32	59	-149	-156	-163	-153	-147
	θ′	0.0	14.5	39.3	20.1	9.2	23.6	19.2	21.4	20.2	24.6	24.4	25.2	26.0	26.2

Table 5.2-PSN4 Principal Strains in Beam PSN4-WDH

SIDE A

Principal Strains (x10^{6})

STATION	APPLIED SHEAR(KN)	30.0	60.0	75.0	90.0	97.5	105.0	112.5	120.0	135.0	150.0	165.0	180.0	195.0	202.5
11	e1	55	97	120	134	154	157	206	1363	2377	3355	4526	5703	7638	8947
	e2	-15	-33	-40	-37	-41	-27	-36	97	408	688	953	1262	1739	2037
	θ′	27.2	30.1	22.5	20.6	24.2	26.1	32.1	54.1	57.0	58.4	59.5	59.7	60.8	61.4
12	e1	42	94	144	174	217	183	883	2475	3878	5250	6831	8455	11040	12720
	e2	-9	-21	-31	-28	-23	-46	150	42	-214	-392	-697	-950	-1452	-1769
	θ′	9.2	19.6	16.8	14.3	9.8	23.9	48.8	60.6	62.4	63.3	63.8	64.3	64.9	65.1
13	e1	44	144	167	245	345	654	2035	3491	3613	3650	3782	4036	4308	4439
	e2	-36	-31	-38	-75	-168	-235	-171	-489	-215	-107	-21	-25	131	225
	θ′	22.5	16.8	9.2	23.5	30.9	37.1	51.2	57.3	60.7	60.7	60.7	60.8	61.9	62.7
14	e1	107	193	311	422	574	803	772	789	832	938	1037	1153	1317	1418
	e2	-10	-32	-12	-83	-57	-68	-78	-79	-65	-58	-85	-80	-83	-127
	θ′	8.0	10.5	6.5	19.9	16.2	19.9	19.4	17.6	16.6	15.9	20.2	22.8	25.5	27.8
15	e1	19	66	91	122	133	143	888	1490	2891	4124	5584	7112	9428	10983
	e2	-3	15	14	-33	-20	-6	-839	-271	-736	-1009	-1395	-1818	-2383	-2711
	θ′	22.5	35.8	9.2	31.1	29.0	33.8	45.3	69.2	65.5	65.8	65.5	65.2	65.4	65.5
16	e1	39	67	96	115	117	94	681	2264	3622	4871	6061	7505	9717	11344
	e2	-31	-10	-23	-18	-36	-29	-3	-351	-168	302	1695	2066	2581	1972
	θ′	17.8	9.2	14.2	7.0	9.2	33.4	80.4	68.5	67.0	66.3	65.9	66.1	66.6	66.8
17	e1	44	116	114	156	206	666	1731	2866	4061	5338	6690	8077	10193	11558
	e2	-3	-36	-41	-27	-101	-29	472	798	563	101	-330	-684	-1244	-1567
	θ′	15.5	29.0	31.1	22.5	30.0	37.3	50.7	53.9	57.5	59.5	60.7	61.5	62.4	62.9
18	e1	47	116	161	213	287	387	318	300	324	522	847	1039	1296	1421
	e2	-23	-11	-8	-43	-20	-32	21	47	71	-62	-169	-215	-392	-453
	θ′	17.8	9.2	12.7	12.1	15.0	33.7	30.3	26.4	18.6	28.7	28.7	29.1	29.1	29.7

Table 5.2-PSN4 Principal Strains in Beam PSN4-WDH

SIDE B

STATION	APPLIED SHEAR(KN)	30.0	60.0	75.0	90.0	97.5	105.0	112.5	120.0	135.0	150.0	165.0	180.0	195.0	202.5
		Principal Strains $(\times 10^6)$													
	e1	10	51	176	153	127	164	208	216	2120	3150	4327	5365	7136	7895
11	e2	-10	-61	8	10	-35	-1	-24	-12	-355	-580	-798	-755	-934	-1816
	θ′	45.0	42.4	7.0	0.0	9.2	3.6	7.6	13.3	61.6	62.7	63.6	63.4	63.5	59.2
	e1	41	55	92	124	165	132	176	668	3227	4455	5992	7654	9951	11469
12	e2	-51	-4	-21	-32	-63	-101	-74	-148	456	686	679	516	841	924
	θ′	41.8	15.5	2.6	5.7	13.3	33.4	27.5	49.7	60.9	62.3	63.1	64.4	65.5	66.0
	e1	49	92	159	204	218	237	745	1608	3907	5225	6615	8051	10069	11384
13	e2	-70	-72	-47	-61	-86	-155	428	381	-1744	-2696	-3637	-5022	-6896	-8089
	θ′	29.5	30.1	16.5	11.3	25.2	31.1	55.4	49.1	45.3	46.1	46.3	45.9	45.5	45.3
	e1	72	110	247	382	500	776	1336	1510	1788	1866	2003	2084	2228	2298
14	e2	-0	-59	-2	-25	-92	-236	-806	-929	-1105	-1121	-1095	-1074	-1167	-1206
	θ′	49.1	32.5	17.5	19.4	23.2	24.5	35.3	35.9	37.1	36.2	34.9	34.5	34.8	35.0
	e1	53	63	76	113	113	113	124	105	100	117	598	1202	1910	2344
15	e2	-63	-84	16	-52	-31	-52	-73	-95	-131	-178	-241	-355	-431	-477
	θ′	71.1	61.8	60.5	59.9	49.1	48.6	49.5	52.4	69.3	73.2	81.9	77.8	77.2	78.6
	e1	51	74	97	125	149	164	98	137	3446	3395	4844	6406	8549	9981
16	e2	-82	-166	-77	-85	-77	-133	-160	-259	-264	623	949	1386	1783	2045
	θ′	47.2	51.1	34.7	30.5	35.8	42.0	35.8	39.1	66.5	68.7	67.7	67.5	68.0	68.1
	e1	33	80	93	119	169	410	984	1714	3715	4983	6272	7725	9619	10931
17	e2	18	-8	29	14	14	-217	26	326	-2	-148	-417	-758	-1174	-1506
	θ′	22.5	17.8	9.2	14.5	11.6	34.0	37.9	45.0	56.0	57.2	58.9	59.8	61.2	61.6
	e1	83	123	154	258	213	261	670	1154	2010	2052	1950	1910	1898	1961
18	e2	19	-21	9	38	-20	-88	-619	-1113	-2030	-2001	-1838	-1727	-1786	-1940
	θ′	9.2	4.1	4.1	6.7	11.6	37.4	40.7	43.5	44.4	43.9	43.8	43.4	44.0	43.7

Table 5.2-PSN5 Principal Strains in Beam PSN5-S6M

SIDE A

STATION	APPLIED SHEAR (KN)	30.0	60.0	75.0	90.0	97.5	105.0	120.0	135.0	150.0	165.0	180.0	195.0	210.0
	Principal Strains ($\times 10^6$)													
	e1	25	41	73	88	817	95	250	1451	2348	3999	5373	6955	8698
11	e2	-1	-49	-41	-15	-728	-31	-210	-490	-799	-1586	-2193	-3114	-4146
	θ′	35.8	42.4	22.5	22.5	-43.1	25.1	44.5	55.3	58.1	59.9	60.1	59.8	59.4
	e1	50	102	141	163	186	226	1586	3327	4709	6295	9078	11569	13936
12	e2	-58	-70	-36	-66	-89	-65	-658	-1221	472	420	-121	431	1502
	θ′	38.5	24.4	15.0	22.5	24.9	16.8	56.8	51.5	56.7	63.2	60.1	60.3	60.5
	e1	60	117	194	242	282	370	2188	4172	5595	7775	9819	12253	15263
13	e2	-20	-20	-16	-24	-40	-96	281	-72	-212	-407	-595	-1052	-2472
	θ′	22.5	22.5	16.2	17.6	18.4	28.2	52.6	58.3	59.7	60.7	61.1	61.6	61.4
	e1	68	161	219	245	293	690	1072	1282	1472	1884	1921	2132	2359
14	e2	-19	-32	-41	-43	-34	4	284	340	376	-471	549	668	748
	θ′	10.9	0.0	3.6	5.7	10.1	23.5	27.5	28.1	29.7	26.8	32.5	33.5	34.0
	e1	34	77	91	116	132	127	97	531	943	908	892	869	844
15	e2	-17	-21	-42	-68	-83	-62	-81	-87	-168	-206	-303	-336	-424
	θ′	54.2	32.8	38.0	37.4	38.5	35.0	45.0	77.2	77.1	79.6	81.1	81.0	82.6
	e1	50	74	102	108	126	145	1590	3397	4658	6649	8513	10736	7919
16	e2	-58	-42	-37	-52	-62	-65	-1727	-2275	-2915	-3873	-4865	-5822	-1294
	θ′	38.5	28.2	27.2	24.5	29.5	33.7	44.9	51.5	52.8	53.6	53.9	54.5	71.1
	e1	57	95	138	149	189	170	1685	3188	4256	5865	7362	9113	11015
17	e2	-32	-31	-33	-4	-28	-48	98	476	731	1123	1580	2031	2583
	θ′	42.4	25.1	22.5	16.0	13.3	25.5	51.9	55.5	57.2	58.5	59.7	59.9	60.2
	e1	45	99	140	192	196	489	848	1033	1211	1429	1610	1816	2009
18	e2	-13	-42	-68	-71	-91	19	274	355	460	565	642	709	775
	θ′	16.8	15.5	17.8	13.7	10.8	19.7	33.0	36.0	36.6	39.3	41.4	43.5	45.2

Table 5.2-PSN5 Principal Strains in Beam PSN5-S6M

SIDE B

STATION	APPLIED SHEAR(KN)	30.0	60.0	75.0	90.0	97.5	105.0	120.0	135.0	150.0	165.0	180.0	195.0	210.0
		Principal Strains ($\times 10^6$)												
11	e1	61	71	82	23	68	74	82	1092	2483	4108	5684	6672	9543
	e2	-31	10	-31	8	24	28	10	-593	241	-1375	-900	-6377	-2872
	θ′	48.2	45.0	42.4	67.5	22.5	13.3	22.5	57.0	56.9	61.6	62.3	46.7	63.4
12	e1	17	66	86	113	131	125	368	2702	4441	6262	8168	10359	12672
	e2	-27	-25	-24	-11	-19	-23	-215	195	536	776	1053	1484	1781
	θ′	22.5	13.3	10.9	4.7	14.2	8.0	43.5	56.0	58.7	60.2	61.1	61.5	62.4
13	e1	42	94	145	191	222	284	1553	2673	4413	6082	7836	9470	11039
	e2	-22	-22	-23	-28	-39	-19	-564	-174	-1812	-2941	-3980	-6268	-8581
	θ′	9.2	7.6	7.0	10.9	19.3	21.1	74.8	51.9	48.0	47.9	44.2	46.0	44.3
14	e1	41	126	169	265	303	417	1245	1393	1573	1594	1693	1793	1914
	e2	-31	-75	-77	-71	-68	-60	-102	116	69	170	204	227	269
	θ′	4.1	7.4	8.5	9.8	15.8	22.5	45.9	51.5	50.3	50.6	49.7	49.1	48.6
15	e1	41	71	92	106	92	127	102	60	245	523	1309	3890	5857
	e2	0	-31	-41	-55	-102	-66	-102	-91	-561	-1012	-2268	-4910	-6948
	θ′	0.0	26.6	28.8	27.7	43.5	29.0	45.0	59.2	44.6	42.7	43.2	43.8	44.3
16	e1	31	45	82	88	96	86	65	1556	4200	6099	8327	9976	12145
	e2	-1	-14	-20	-27	-14	-15	-45	-750	-1242	-142	833	663	809
	θ′	9.2	15.5	18.4	22.5	10.9	22.5	34.1	49.7	50.4	58.6	64.7	59.7	59.7
17	e1	80	96	82	113	126	156	1083	3079	4536	6350	7283	9870	11711
	e2	-8	37	30	29	48	27	-583	-1284	-1731	-1341	-6181	-2332	-1633
	θ′	72.2	74.5	50.7	38.0	33.4	35.8	53.0	47.5	52.6	60.0	45.2	61.4	61.2
18	e1	61	112	144	186	281	447	1075	1361	1394	1452	1898	1522	1583
	e2	-31	-41	-52	-54	-108	-151	37	292	361	384	999	395	406
	θ′	3.2	1.9	4.5	6.1	15.0	18.3	22.9	38.4	40.5	41.7	88.7	42.4	42.8

Table 5.2-PSN6 Principal Strains in Beam PSN6-WS

SIDE A

Principal Strains ($x10^{6}$)

STATION	APPLIED SHEAR(KN)	30.0	60.0	75.0	90.0	97.5	105.0	112.5	120.0	135.0	150.0	165.0	180.0	195.0	210.0
11	e1	65	90	95	115	151	176	199	388	811	1573	2181	2964	3591	4289
	e2	8	-26	-39	-51	-38	-95	-87	-308	-464	-758	-1003	-1447	-1856	-2353
	θ′	22.5	28.2	32.5	30.5	29.5	36.3	36.8	47.0	52.2	56.7	58.1	58.4	58.0	57.7
12	e1	45	95	112	173	187	218	383	1307	2587	3822	5055	6529	8049	9687
	e2	-13	-31	-63	-36	-66	-73	-222	-1420	-1143	-1611	-1633	-1227	-980	-624
	θ′	16.8	19.9	28.2	17.8	26.4	28.2	40.4	41.9	56.3	57.1	56.6	55.5	54.3	53.9
13	e1	42	130	153	200	223	278	679	1792	3097	4313	5619	7380	8966	10954
	e2	-74	-98	-89	-87	-77	-109	-324	-146	147	432	175	-488	-162	-1762
	θ′	28.2	22.5	18.4	19.1	18.1	29.3	46.8	52.5	53.9	55.0	56.6	58.0	58.1	59.7
14	e1	91	214	260	331	358	642	1057	1535	1696	1900	2103	2377	2650	2923
	e2	-35	-37	-42	-80	-92	-37	137	321	426	433	471	480	490	531
	θ′	22.5	7.5	10.2	21.7	26.9	34.9	34.2	43.1	43.0	42.3	41.7	42.3	43.0	43.6
15	e1	68	108	107	158	172	187	180	210	210	194	188	176	210	187
	e2	-44	-76	-67	-118	-116	-130	-115	-186	-227	-218	-269	-370	-412	-478
	θ′	34.5	37.4	38.3	37.4	39.3	41.3	40.3	44.4	47.1	46.7	49.1	54.5	54.5	56.4
16	e1	44	73	100	141	152	152	120	76	89	73	1037	2081	3403	4946
	e2	-28	-32	-60	-101	-55	-47	-55	-92	-186	-137	-173	-193	-514	-1032
	θ′	13.3	28.8	24.5	32.1	25.7	29.1	28.2	36.7	43.3	56.3	75.4	83.2	73.4	69.1
17	e1	41	97	94	128	133	110	221	1205	2365	3401	4434	5722	6976	8304
	e2	-33	-33	-54	-71	-77	-53	-197	-576	-364	-148	20	234	432	710
	θ′	41.8	30.1	33.8	34.3	37.2	28.5	35.4	47.3	51.3	52.4	53.0	53.6	53.9	54.4
18	e1	113	158	221	391	530	668	953	1603	1764	1882	2024	2180	2356	2567
	e2	-57	-109	-117	-189	-223	-894	-784	27	205	248	292	338	323	371
	θ′	32.3	32.5	28.3	27.6	27.3	48.6	46.5	30.3	34.4	34.9	34.8	35.5	36.9	38.0

Table 5.2-PSN6 Principal Strains in Beam PSN6-WS

SIDE B

Principal Strains ($x10^6$)

STATION	APPLIED SHEAR(KN)	30.0	60.0	75.0	90.0	97.5	105.0	112.5	120.0	135.0	150.0	165.0	180.0	195.0	210.0
11	e1	61	61	77	86	112	125	125	267	1603	3053	4046	5179	6452	8344
	e2	-41	-41	-46	-76	-71	-85	-54	-216	-644	-942	-1017	-1120	-1250	-1337
	θ′	26.6	26.6	32.8	35.8	31.7	30.5	29.5	42.0	56.8	60.6	61.0	61.2	61.4	62.5
12	e1	94	94	127	147	184	221	217	1079	2862	4467	5795	7236	8902	11083
	e2	-53	-53	-35	-55	-62	-140	-43	-294	320	571	631	720	798	861
	θ′	28.2	28.2	17.3	20.5	20.8	21.4	24.1	49.5	54.4	57.9	58.9	59.9	60.9	62.3
13	e1	143	143	192	231	264	302	489	1873	3926	4657	4322	4101	4131	4191
	e2	-31	-31	-29	-58	-39	-47	-152	35	-499	-373	-293	-337	-388	-550
	θ′	20.1	20.1	16.8	21.1	21.1	26.1	38.1	51.9	58.3	61.5	60.4	58.0	56.6	54.2
14	e1	92	92	138	183	269	433	770	882	909	992	1047	1183	1268	1415
	e2	-133	-133	-159	-172	-137	-137	-15	-158	-144	-135	-108	-133	-95	-120
	θ′	42.4	42.4	37.0	35.8	30.8	30.6	31.1	34.4	32.1	29.2	27.2	27.2	25.2	24.9
15	e1	66	66	84	95	108	107	138	102	429	1989	3174	4486	5845	7637
	e2	-25	-25	-64	-54	-47	-35	-56	-82	-571	-2315	-3358	-4476	-5529	-7107
	θ′	31.7	31.7	37.0	37.0	33.4	34.5	35.8	45.0	45.6	44.7	46.0	46.7	47.4	47.5
16	e1	94	94	91	118	142	160	151	1220	2143	3860	5261	5449	8257	10258
	e2	-53	-53	-60	-57	-91	-98	-69	35	682	240	-151	640	892	1350
	θ′	28.2	28.2	30.8	34.7	33.4	35.8	34.1	24.2	65.2	65.0	64.4	62.8	64.1	64.4
17	e1	181	181	205	236	264	334	604	1840	3405	4684	5963	7368	8875	10677
	e2	-109	-109	-144	-145	-162	-242	-512	-127	399	497	-149	-779	-1205	-1680
	θ′	35.8	35.8	34.7	34.8	36.7	38.4	42.6	47.7	51.6	54.1	56.7	58.3	59.4	60.3
18	e1	207	207	167	209	275	377	610	1309	2295	2919	2964	2939	2846	2835
	e2	-85	-85	-65	-36	10	51	73	-768	-1785	-1368	-2475	-1348	-1224	-2192
	θ′	39.0	39.0	26.1	8.5	0.0	0.0	7.2	38.9	42.1	49.1	43.1	49.1	49.1	42.5

Table 5.3-PSN1 Crack Widths in Beam PSN1-0

	APPLIED				SIDE A				
STATION	SHEAR(KN)	75.0	90.0	105.0	112.0	120.0	127.5	135.0	142.5
					Crack Widths (mm)				
2	w	0.00	0.00	0.00	0.00	0.01	0.02	0.04	0.07
3	w	0.00	0.00	0.00	0.11	0.17	0.19	0.21	0.23
4	w	0.00	0.00	0.01	0.11	0.17	0.19	0.20	0.23
5	w	0.00	0.02	0.04	0.07	0.11	0.13	0.14	0.15
6	w	0.04	0.09	0.17	0.19	0.25	0.27	0.30	0.31
7	w	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
8	w	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
9	w	0.00	0.00	0.00	0.07	0.18	0.23	0.28	0.32
9A	w	0.00	0.00	0.02	0.11	0.10	0.11	0.10	0.11
10	w	0.04	0.09	0.11	0.13	0.18	0.21	0.23	0.26
	w	0.00	0.00	0.00	0.86	1.36	1.63	1.92	2.20
	w1	0.00	0.00	0.00	0.73	1.17	1.39	1.65	1.89
11	w2	0.00	0.00	0.00	0.81	1.27	1.52	1.79	2.05
	w3	0.00	0.00	0.00	1.21	1.85	2.21	2.57	2.92
	w	0.00	0.00	0.00	1.13	1.58	1.97	2.27	2.56
	w1	0.00	0.00	0.00	0.98	1.48	1.75	2.03	2.30
12	w2	0.00	0.00	0.00	1.05	1.47	1.85	2.13	2.41
	w3	0.00	0.00	0.00	1.11	1.43	1.93	2.22	2.52
	w	0.00	0.00	0.06	1.15	1.64	1.93	2.20	2.47
	w1	0.00	0.00	0.01	0.78	1.12	1.32	1.51	1.70
13	w2	0.00	0.00	0.06	1.06	1.53	1.79	2.05	2.30
	w3	0.00	0.00	0.04	1.15	1.67	1.97	2.25	2.53
	w	0.00	0.00	0.12	0.29	0.30	0.32	0.32	0.35
	w1	0.00	0.00	0.08	0.19	0.21	0.22	0.23	0.25
14	w2	0.00	0.00	0.12	0.29	0.30	0.32	0.32	0.35
	w3	0.00	0.00	0.09	0.24	0.25	0.27	0.27	0.30
	w	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	w1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
15	w2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	w3	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	w	0.00	0.00	0.00	0.95	1.49	1.79	2.08	2.36
	w1	0.00	0.00	0.00	0.71	1.14	1.37	1.59	1.82
16	w2	0.00	0.00	0.00	0.84	1.33	1.60	1.86	2.11
	w3	0.00	0.00	0.00	1.13	1.75	2.09	2.41	2.73
	w	0.00	0.00	0.00	0.92	1.34	1.57	1.79	2.02
	w1	0.00	0.00	0.00	0.71	1.10	1.32	1.52	1.72
17	w2	0.00	0.00	0.00	0.85	1.26	1.49	1.70	1.91
	w3	0.00	0.00	0.00	0.94	1.36	1.59	1.81	2.03
	w	0.00	0.01	0.12	0.31	0.29	0.34	0.35	0.37
	w1	0.00	0.01	0.10	0.26	0.27	0.28	0.29	0.31
18	w2	0.00	0.03	0.12	0.28	0.11	0.30	0.31	0.32
	w3	0.00	0.01	0.10	0.26	0.16	0.28	0.29	0.30

Table 5.3-PSN1 Crack Widths in Beam PSN1-0

STATION	APPLIED SHEAR (KN)	75.0	90.0	105.0	112.0	120.0	127.5	135.0	142.5
		SIDE B Crack Widths (mm)							
2	w	0.00	0.00	0.00	0.02	0.04	0.07	0.08	0.00
3	w	0.00	0.00	0.00	0.03	0.05	0.06	0.06	0.08
4	w	0.00	0.00	0.08	0.12	0.15	0.17	0.18	0.22
5	w	0.00	0.00	0.09	0.12	0.16	0.18	0.20	0.22
6	w	0.03	0.07	0.12	0.14	0.19	0.21	0.24	0.27
7	w	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
8	w	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
9	w	0.00	0.00	0.08	0.22	0.30	0.35	0.39	0.46
9A	w	0.00	0.00	0.00	0.00	0.00	0.01	0.01	0.01
	w	0.00	0.00	0.00	1.33	1.85	2.25	2.66	3.15
	w1	0.00	0.00	0.00	1.15	1.61	1.97	2.33	2.76
11	w2	0.00	0.00	0.00	1.24	1.73	2.10	2.49	2.95
	w3	0.00	0.00	0.00	1.73	2.37	2.86	3.36	3.94
	w	0.00	0.00	0.54	2.00	2.63	3.09	3.58	22.12
	w1	0.00	0.00	0.40	1.77	2.35	2.78	3.23	17.80
12	w2	0.00	0.00	0.49	1.86	2.46	2.89	3.35	20.10
	w3	0.00	0.00	0.61	1.99	2.60	3.06	3.53	24.07
	w	0.00	0.00	0.62	1.71	2.21	2.59	2.97	18.21
	w1	0.00	0.00	0.46	1.18	1.54	1.80	2.08	12.01
13	w2	0.00	0.00	0.56	1.57	2.05	2.40	2.75	17.88
	w3	0.00	0.00	0.52	1.49	1.94	2.28	2.62	16.91
	w	0.00	0.02	0.04	0.06	0.07	0.08	0.09	0.10
	w1	0.00	0.01	0.03	0.05	0.06	0.07	0.09	0.09
14	w2	0.00	0.03	0.04	0.05	0.07	0.08	0.08	0.08
	w3	0.00	0.01	0.03	0.05	0.06	0.07	0.09	0.09
	w	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	w1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
15	w2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	w3	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	w	0.00	0.00	0.41	1.73	2.36	2.83	3.30	11.30
	w1	0.00	0.00	0.15	1.18	1.68	2.06	2.45	2.93
16	w2	0.00	0.00	0.39	1.56	2.13	2.54	2.97	10.82
	w3	0.00	0.00	0.84	2.28	2.97	3.46	3.95	24.71
	w	0.00	0.00	0.61	1.66	2.18	2.55	2.94	19.42
	w1	0.00	0.00	0.49	1.38	1.82	2.13	2.46	13.62
17	w2	0.00	0.00	0.54	1.44	1.90	2.22	2.56	18.53
	w3	0.00	0.00	0.53	1.43	1.88	2.20	2.54	18.51
	w	0.00	0.00	0.05	0.07	0.10	0.12	0.13	0.14
	w1	0.00	0.00	0.03	0.05	0.07	0.08	0.09	0.10
18	w2	0.00	0.02	0.07	0.09	0.11	0.13	0.15	0.16
	w3	0.00	0.00	0.03	0.05	0.07	0.09	0.09	0.11

Table 5.3-PSN2 Crack Widths in Beam PSN2-WD

STATION	APPLIED SHEAR(KN)	75.0	90.0	97.5	105.0	112.5	120.0	135.0	150.0	165.0	180.0	195.0	202.5
		SIDE A Crack Widths (mm)											
2	w	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.04	0.07	0.10	0.13	0.15
3	w	0.00	0.00	0.00	0.00	0.00	0.02	0.08	0.11	0.14	0.17	0.21	0.24
4	w	0.00	0.00	0.01	0.04	0.09	0.12	0.16	0.19	0.22	0.25	0.29	0.30
5	w	0.00	0.01	0.03	0.05	0.09	0.10	0.15	0.19	0.22	0.27	0.31	0.33
6	w	0.02	0.03	0.06	0.08	0.10	0.10	0.15	0.18	0.21	0.24	0.27	0.29
7	w	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
8	w	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
9	w	0.00	0.00	0.00	0.00	0.00	0.02	0.09	0.17	0.24	0.31	0.39	0.43
9A	w	0.00	0.00	0.01	0.03	0.07	0.07	0.08	0.07	0.07	0.07	0.07	0.07
10	w	0.00	0.04	0.06	0.08	0.11	0.12	0.15	0.19	0.23	0.26	0.30	0.31
	w	0.00	0.00	0.00	0.00	0.00	0.04	0.35	0.51	0.77	0.89	1.13	1.31
	w1	0.00	0.00	0.00	0.00	0.00	0.01	0.19	0.31	0.60	0.61	0.80	0.92
11	w2	0.00	0.00	0.00	0.00	0.00	0.04	0.30	0.45	0.70	0.81	1.03	1.20
	w3	0.00	0.00	0.00	0.00	0.00	0.07	0.39	0.53	0.74	0.93	1.16	1.37
	w	0.00	0.00	0.00	0.00	0.15	0.30	0.64	0.86	1.12	1.38	1.72	1.94
	w1	0.00	0.00	0.00	0.00	0.08	0.19	0.47	0.63	0.82	1.02	1.29	1.47
12	w2	0.00	0.00	0.00	0.00	0.13	0.27	0.59	0.79	1.03	1.27	1.59	1.79
	w3	0.00	0.00	0.00	0.00	0.19	0.32	0.67	0.91	1.18	1.46	1.82	2.04
	w	0.00	0.00	0.00	0.10	0.29	0.41	0.46	0.44	0.44	0.46	0.49	0.50
	w1	0.00	0.00	0.00	0.06	0.19	0.25	0.31	0.30	0.29	0.31	0.33	0.33
13	w2	0.00	0.00	0.00	0.10	0.30	0.41	0.45	0.44	0.45	0.48	0.50	0.52
	w3	0.00	0.00	0.00	0.07	0.24	0.33	0.38	0.37	0.37	0.39	0.42	0.43
	w	0.00	0.00	0.10	0.12	0.13	0.14	0.17	0.18	0.20	0.23	0.26	0.27
	w1	0.00	0.00	0.07	0.10	0.11	0.13	0.15	0.16	0.19	0.21	0.24	0.26
14	w2	0.00	0.00	0.10	0.11	0.12	0.13	0.16	0.17	0.19	0.22	0.24	0.26
	w3	0.00	0.00	0.07	0.09	0.10	0.11	0.14	0.15	0.17	0.20	0.22	0.24
	w	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	w1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
15	w2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	w3	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	w	0.00	0.00	0.00	0.00	0.00	0.00	0.45	0.67	0.92	1.17	1.48	1.69
	w1	0.00	0.00	0.00	0.00	0.00	0.00	0.34	0.55	0.81	1.04	1.33	1.53
16	w2	0.00	0.00	0.00	0.00	0.00	0.00	0.40	0.61	0.87	1.10	1.41	1.61
	w3	0.00	0.00	0.00	0.00	0.00	0.00	0.42	0.64	0.89	1.13	1.44	1.64
	w	0.00	0.00	0.00	0.03	0.24	0.34	0.57	0.77	0.99	1.20	1.45	1.62
	w1	0.00	0.00	0.00	0.02	0.21	0.30	0.48	0.57	0.67	0.79	0.94	1.05
17	w2	0.00	0.00	0.00	0.03	0.22	0.32	0.54	0.73	0.94	1.14	1.39	1.56
	w3	0.00	0.00	0.00	0.01	0.21	0.31	0.54	0.74	0.97	1.19	1.46	1.63
	w	0.00	0.00	0.05	0.10	0.12	0.13	0.15	0.16	0.16	0.17	0.18	0.19
	w1	0.00	0.00	0.05	0.09	0.12	0.13	0.15	0.16	0.17	0.18	0.20	0.21
18	w2	0.00	0.00	0.03	0.08	0.11	0.11	0.13	0.13	0.13	0.14	0.16	0.16
	w3	0.00	0.00	0.04	0.07	0.10	0.10	0.11	0.12	0.12	0.14	0.15	0.16

Table 5.3-PSN2 Crack Widths in Beam PSN2-WD

STATION	APPLIED SHEAR(KN)	75.0	90.0	97.5	105.0	112.5	120.0	135.0	150.0	165.0	180.0	195.0	202.5
		SIDE B — Crack Widths (mm)											
2	w	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.03	0.06	0.07
3	w	0.00	0.00	0.00	0.00	0.01	0.03	0.10	0.13	0.18	0.23	0.29	0.34
4	w	0.00	0.00	0.00	0.03	0.07	0.08	0.12	0.15	0.17	0.20	0.27	0.26
5	w	0.00	0.00	0.02	0.10	0.12	0.18	0.19	0.24	0.27	0.31	0.35	0.37
6	w	0.03	0.07	0.10	0.13	0.15	0.18	0.22	0.25	0.36	0.34	0.37	0.39
7	w	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
8	w	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.09	0.13
9	w	0.00	0.00	0.00	0.00	0.04	0.06	0.13	0.19	0.26	0.28	0.26	0.26
9A	w	0.00	0.00	0.00	0.02	0.03	0.03	0.04	0.05	0.05	0.05	0.05	0.05
	w	0.00	0.00	0.00	0.00	0.00	0.00	0.33	0.32	0.70	1.05	1.47	1.74
	w1	0.00	0.00	0.00	0.00	0.00	0.00	0.24	0.17	0.58	0.89	1.26	1.51
11	w2	0.00	0.00	0.00	0.00	0.00	0.00	0.30	0.29	0.64	0.96	1.34	1.60
	w3	0.00	0.00	0.00	0.00	0.00	0.00	0.44	0.57	0.79	1.13	1.54	1.80
	w	0.00	0.00	0.00	0.00	0.27	0.36	0.69	0.89	1.06	1.34	1.72	2.03
	w1	0.00	0.00	0.00	0.00	0.20	0.29	0.55	0.70	0.95	1.30	1.70	1.98
12	w2	0.00	0.00	0.00	0.00	0.25	0.33	0.63	0.82	1.00	1.20	1.59	1.86
	w3	0.00	0.00	0.00	0.00	0.25	0.34	0.70	0.92	1.03	1.02	1.01	1.05
	w	0.00	0.00	0.00	0.19	0.41	0.48	0.54	0.56	0.58	0.60	0.65	0.68
	w1	0.00	0.00	0.00	0.12	0.26	0.32	0.38	0.39	0.39	0.41	0.44	0.46
13	w2	0.00	0.00	0.00	0.18	0.38	0.44	0.50	0.52	0.54	0.56	0.61	0.64
	w3	0.00	0.00	0.00	0.16	0.37	0.43	0.49	0.51	0.53	0.56	0.61	0.64
	w	0.00	0.00	0.07	0.08	0.10	0.11	0.14	0.17	0.20	0.23	0.27	0.29
	w1	0.00	0.00	0.04	0.06	0.07	0.08	0.11	0.13	0.16	0.18	0.21	0.23
14	w2	0.00	0.00	0.07	0.08	0.09	0.10	0.14	0.17	0.20	0.23	0.26	0.29
	w3	0.00	0.00	0.04	0.05	0.06	0.08	0.11	0.14	0.16	0.20	0.23	0.25
	w	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.52	0.94	1.45	1.76
	w1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.47	0.78	1.17	1.41
15	w2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.47	0.83	1.29	1.56
	w3	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.52	1.03	1.61	1.95
	w	0.00	0.00	0.00	0.00	0.00	0.00	0.71	0.90	1.17	1.58	2.05	2.36
	w1	0.00	0.00	0.00	0.00	0.00	0.00	0.55	0.74	0.99	1.38	1.81	2.11
16	w2	0.00	0.00	0.00	0.00	0.00	0.00	0.64	0.82	1.08	1.47	1.91	2.21
	w3	0.00	0.00	0.00	0.00	0.00	0.00	0.78	0.96	1.21	1.59	2.05	2.36
	w	0.00	0.00	0.00	0.15	0.37	0.44	0.70	0.90	1.16	1.23	1.25	1.31
	w1	0.00	0.00	0.00	0.12	0.30	0.39	0.58	0.68	0.82	0.92	0.97	1.03
17	w2	0.00	0.00	0.00	0.14	0.35	0.41	0.66	0.84	1.08	1.14	1.15	1.21
	w3	0.00	0.00	0.00	0.12	0.34	0.40	0.68	0.89	1.17	1.22	1.20	1.26
	w	0.00	0.00	0.04	0.08	0.09	0.09	0.11	0.14	0.16	0.18	0.20	0.22
	w1	0.00	0.00	0.02	0.05	0.06	0.06	0.08	0.10	0.12	0.13	0.15	0.16
18	w2	0.00	0.00	0.04	0.09	0.09	0.10	0.12	0.14	0.16	0.18	0.21	0.23
	w3	0.00	0.00	0.02	0.05	0.06	0.07	0.09	0.11	0.12	0.14	0.16	0.18

Table 5.3-PSN3 Crack Widths in Beam PSN3-D2

STATION	APPLIED SHEAR (KN)	SIDE A											
		75.0	90.0	97.5	105.0	112.5	120.0	135.0	150.0	165.0	180.0	195.0	210.0
		Crack Widths (mm)											
2	w	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.03	0.06	0.08	0.13
3	w	0.00	0.00	0.00	0.00	0.00	0.06	0.10	0.14	0.19	0.22	0.28	0.32
4	w	0.00	0.00	0.00	0.03	0.04	0.10	0.11	0.14	0.16	0.19	0.23	0.26
5	w	0.02	0.05	0.08	0.15	0.17	0.21	0.25	0.30	0.34	0.37	0.41	0.45
6	w	0.01	0.05	0.09	0.11	0.13	0.16	0.20	0.25	0.29	0.33	0.38	0.42
7	w	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
8	w	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
9	w	0.00	0.00	0.00	0.03	0.06	0.15	0.20	0.25	0.31	0.39	0.47	0.56
9A	w	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.02	0.19	0.04	0.04
10	w	0.02	0.08	0.12	0.14	0.15	0.19	0.22	0.26	0.30	0.33	0.37	0.42
	w	0.00	0.00	0.00	0.00	0.00	0.13	0.30	0.43	0.64	0.88	1.19	1.57
	w1	0.00	0.00	0.00	0.00	0.00	0.06	0.16	0.25	0.37	0.61	0.88	1.20
11	w2	0.00	0.00	0.00	0.00	0.00	0.12	0.26	0.39	0.57	0.81	1.11	1.46
	w3	0.00	0.00	0.00	0.00	0.00	0.16	0.31	0.45	0.68	0.91	1.23	1.61
	w	0.00	0.00	0.00	0.00	0.11	0.45	0.66	0.86	1.12	1.49	1.93	2.42
	w1	0.00	0.00	0.00	0.00	0.04	0.32	0.48	0.65	0.82	1.12	1.42	1.78
12	w2	0.00	0.00	0.00	0.00	0.10	0.41	0.60	0.79	1.03	1.37	1.76	2.20
	w3	0.00	0.00	0.00	0.00	0.15	0.47	0.69	0.90	1.20	1.58	2.05	2.57
	w	0.00	0.00	0.00	0.18	0.29	0.33	0.36	0.42	0.50	0.57	0.64	0.71
	w1	0.00	0.00	0.00	0.13	0.22	0.26	0.29	0.33	0.40	0.46	0.52	0.60
13	w2	0.00	0.00	0.00	0.17	0.27	0.31	0.34	0.40	0.47	0.54	0.61	0.68
	w3	0.00	0.00	0.00	0.16	0.27	0.30	0.34	0.40	0.47	0.54	0.62	0.69
	w	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	w1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
14	w2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	w3	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	w	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	w1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
15	w2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	w3	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	w	0.00	0.00	0.00	0.00	0.00	0.29	0.47	0.64	0.88	1.18	1.56	1.97
	w1	0.00	0.00	0.00	0.00	0.00	0.24	0.41	0.58	0.80	1.07	1.41	1.79
16	w2	0.00	0.00	0.00	0.00	0.00	0.27	0.44	0.61	0.83	1.11	1.46	1.85
	w3	0.00	0.00	0.00	0.00	0.00	0.27	0.44	0.61	0.84	1.13	1.48	1.87
	w	0.00	0.00	0.00	0.19	0.28	0.54	0.72	0.91	1.15	1.44	1.79	2.16
	w1	0.00	0.00	0.00	0.15	0.23	0.39	0.49	0.62	0.78	0.98	1.21	1.48
17	w2	0.00	0.00	0.00	0.18	0.26	0.51	0.68	0.86	1.09	1.37	1.70	2.06
	w3	0.00	0.00	0.00	0.16	0.24	0.52	0.70	0.89	1.14	1.43	1.78	2.15
	w	0.00	0.00	0.03	0.02	0.03	0.03	0.04	0.04	0.05	0.05	0.06	0.07
	w1	0.00	0.00	0.02	0.01	0.02	0.02	0.03	0.03	0.04	0.04	0.05	0.05
18	w2	0.00	0.00	0.06	0.05	0.05	0.05	0.07	0.08	0.09	0.10	0.11	0.11
	w3	0.00	0.00	0.02	0.01	0.02	0.02	0.03	0.03	0.04	0.04	0.05	0.06

Table 5.3-PSN3 Crack Widths in Beam PSN3-D2

STATION	APPLIED SHEAR (KN)	75.0	90.0	97.5	105.0	112.5	120.0	135.0	150.0	165.0	180.0	195.0	210.0
		SIDE B											
		Crack Widths (mm)											
2	w	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.02	0.07	0.11	0.16
3	w	0.00	0.00	0.00	0.00	0.00	0.01	0.12	0.15	0.16	0.21	0.24	0.27
4	w	0.00	0.00	0.00	0.00	0.02	0.03	0.08	0.07	0.10	0.14	0.16	0.17
5	w	0.00	0.03	0.07	0.08	0.16	0.20	0.21	0.28	0.31	0.36	0.42	0.47
6	w	0.00	0.02	0.06	0.08	0.14	0.19	0.00	0.25	0.29	0.34	0.36	0.43
7	w	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
8	w	0.00	0.00	0.00	0.00	0.00	0.00	0.02	0.06	0.10	0.16	0.21	0.28
9	w	0.00	0.00	0.00	0.00	0.01	0.05	0.07	0.09	0.10	0.11	0.11	0.12
9A	w	0.00	0.00	0.00	0.00	0.02	0.02	0.01	0.03	0.04	0.04	0.05	0.06
	w	0.00	0.00	0.00	0.00	0.00	0.00	0.26	0.35	0.63	0.92	1.30	1.80
	w1	0.00	0.00	0.00	0.00	0.00	0.00	0.14	0.24	0.44	0.68	1.01	1.38
11	w2	0.00	0.00	0.00	0.00	0.00	0.00	0.23	0.31	0.58	0.85	1.21	1.67
	w3	0.00	0.00	0.00	0.00	0.00	0.00	0.29	0.34	0.65	0.95	1.33	1.85
	w	0.00	0.00	0.00	0.00	0.00	0.00	0.47	0.68	0.97	1.36	1.82	2.40
	w1	0.00	0.00	0.00	0.00	0.00	0.00	0.35	0.50	0.70	0.97	1.32	1.76
12	w2	0.00	0.00	0.00	0.00	0.00	0.00	0.44	0.63	0.89	1.24	1.67	2.20
	w3	0.00	0.00	0.00	0.00	0.00	0.00	0.45	0.67	0.97	1.38	1.85	2.44
	w	0.00	0.00	0.00	0.00	0.12	0.24	0.28	0.33	0.38	0.44	0.49	0.55
	w1	0.00	0.00	0.00	0.00	0.09	0.20	0.25	0.29	0.32	0.39	0.42	0.49
13	w2	0.00	0.00	0.00	0.00	0.11	0.24	0.28	0.32	0.37	0.42	0.48	0.54
	w3	0.00	0.00	0.00	0.00	0.09	0.21	0.25	0.29	0.34	0.40	0.45	0.51
	w	0.00	0.00	0.00	0.08	0.17	0.20	0.23	0.28	0.32	0.37	0.42	0.48
	w1	0.00	0.00	0.00	0.08	0.08	0.09	0.11	0.15	0.16	0.18	0.21	0.24
14	w2	0.00	0.00	0.00	0.04	0.25	0.31	0.35	0.41	0.48	0.57	0.65	0.73
	w3	0.00	0.00	0.00	0.08	0.13	0.16	0.18	0.23	0.27	0.31	0.36	0.41
	w	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	w1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
15	w2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	w3	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	w	0.00	0.00	0.00	0.00	0.00	0.00	0.30	0.46	0.73	1.09	1.51	2.01
	w1	0.00	0.00	0.00	0.00	0.00	0.00	0.26	0.35	0.66	0.96	1.35	1.79
16	w2	0.00	0.00	0.00	0.00	0.00	0.00	0.28	0.42	0.68	1.02	1.40	1.86
	w3	0.00	0.00	0.00	0.00	0.00	0.00	0.28	0.46	0.69	1.05	1.42	1.89
	w	0.00	0.00	0.00	0.00	0.12	0.23	0.50	0.67	0.91	1.17	1.52	1.91
	w1	0.00	0.00	0.00	0.00	0.10	0.21	0.28	0.32	0.39	0.44	0.49	0.56
17	w2	0.00	0.00	0.00	0.00	0.11	0.22	0.48	0.64	0.87	1.13	1.46	1.85
	w3	0.00	0.00	0.00	0.00	0.09	0.20	0.50	0.69	0.94	1.24	1.63	2.08
	w	0.00	0.00	0.00	0.03	0.04	0.03	0.04	0.05	0.06	0.05	0.06	0.08
	w1	0.00	0.00	0.00	0.02	0.03	0.03	0.03	0.04	0.05	0.04	0.05	0.07
18	w2	0.00	0.00	0.00	0.04	0.04	0.04	0.04	0.05	0.06	0.06	0.06	0.07
	w3	0.00	0.00	0.00	0.02	0.03	0.03	0.03	0.04	0.05	0.04	0.05	0.07

Table 5.3-PSN4 Crack Widths in Beam PSN4-WDH

STATION	APPLIED SHEAR(KN)	75.0	90.0	97.5	105.0	112.5	120.0	135.0	150.0	165.0	180.0	195.0	202.5
		SIDE A — Crack Widths (mm)											
2	w	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.03	0.05	0.08	0.10
3	w	0.00	0.00	0.00	0.00	0.01	0.07	0.10	0.13	0.16	0.20	0.26	0.28
4	w	0.00	0.00	0.00	0.00	0.05	0.07	0.10	0.14	0.18	0.20	0.24	0.27
5	w	0.00	0.00	0.01	0.07	0.13	0.15	0.19	0.22	0.24	0.27	0.31	0.33
6	w	0.00	0.00	0.02	0.05	0.05	0.06	0.11	0.00	0.18	0.22	0.25	0.28
7	w	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
8	w	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
9	w	0.00	0.00	0.00	0.02	0.06	0.12	0.20	0.26	0.31	0.37	0.46	0.52
9A	w	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.02	0.04	0.05	0.06
10	w	0.01	0.02	0.04	0.04	0.07	0.08	0.12	0.18	0.23	0.27	0.31	0.35
	w	0.00	0.00	0.00	0.00	0.00	0.22	0.43	0.64	0.88	1.12	1.52	1.78
	w1	0.00	0.00	0.00	0.00	0.00	0.17	0.37	0.55	0.77	0.99	1.35	1.60
11	w2	0.00	0.00	0.00	0.00	0.00	0.20	0.40	0.59	0.82	1.04	1.41	1.66
	w3	0.00	0.00	0.00	0.00	0.00	0.22	0.42	0.61	0.85	1.08	1.47	1.73
	w	0.00	0.00	0.00	0.00	0.13	0.46	0.74	1.01	1.33	1.65	2.16	2.49
	w1	0.00	0.00	0.00	0.00	0.10	0.35	0.55	0,75	0.98	1.21	1.58	1.82
12	w2	0.00	0.00	0.00	0.00	0.12	0.42	0.67	0.92	1.20	1.50	1.96	2.26
	w3	0.00	0.00	0.00	0.00	0.10	0.45	0.75	1.04	1.37	1.71	2.25	2.61
	w	0.00	0.00	0.00	0.08	0.36	0.63	0.66	0.67	0.70	0.75	0.79	0.82
	w1	0.00	0.00	0.00	0.01	0.21	0.38	0.44	0.46	0.49	0.53	0.59	0.62
13	w2	0.00	0.00	0.00	0.09	0.35	0.61	0.62	0.63	0.65	0.70	0.75	0.77
	w3	0.00	0.00	0.00	0.04	0.33	0.61	0.61	0.62	0.64	0.69	0.74	0.76
	w	0.00	0.03	0.06	0.11	0.10	0.10	0.11	0.13	0.15	0.18	0.21	0.23
	w1	0.00	0.02	0.05	0.08	0.07	0.08	0.09	0.11	0.12	0.13	0.15	0.16
14	w2	0.00	0.04	0.06	0.11	0.11	0.11	0.11	0.13	0.16	0.19	0.23	0.26
	w3	0.00	0.02	0.05	0.08	0.07	0.08	0.09	0.11	0.12	0.14	0.17	0.18
	w	0.00	0.00	0.00	0.00	0.00	0.27	0.54	0.79	1.08	1.38	1.84	2.15
	w1	0.00	0.00	0.00	0.00	0.00	0.21	0.40	0.58	0.79	1.00	1.34	1.57
15	w2	0.00	0.00	0.00	0.00	0.00	0.23	0.48	0.69	0.95	1.22	1.63	1.91
	w3	0.00	0.00	0.00	0.00	0.00	0.28	0.62	0.89	1.23	1.58	2.10	2.45
	w	0.00	0.00	0.00	0.00	0.00	0.42	0.70	0.94	1.19	1.48	1.92	2.24
	w1	0.00	0.00	0.00	0.00	0.00	0.33	0.56	0.81	1.14	1.41	1.84	2.05
16	w2	0.00	0.00	0.00	0.00	0.00	0.37	0.63	0.87	1.14	1.42	1.84	2.12
	w3	0.00	0.00	0.00	0.00	0.00	0.44	0.70	0.94	1.12	1.40	1.83	2.20
	w	0.00	0.00	0.00	0.09	0.31	0.54	0.78	1.02	1.28	1.54	1.93	2.18
	w1	0.00	0.00	0.00	0.05	0.27	0.48	0.63	0.76	0.91	1.08	1.33	1.49
17	w2	0.00	0.00	0.00	0.09	0.30	0.52	0.74	0.97	1.21	1.45	1.82	2.06
	w3	0.00	0.00	0.00	0.07	0.29	0.51	0.75	1.01	1.27	1.54	1.94	2.20
	w	0.00	0.00	0.01	0.04	0.02	0.02	0.02	0.06	0.13	0.17	0.22	0.24
	w1	0.00	0.00	0.01	0.01	0.00	0.01	0.01	0.03	0.07	0.09	0.12	0.13
18	w2	0.00	0.00	0.01	0.04	0.02	0.01	0.01	0.07	0.14	0.18	0.25	0.28
	w3	0.00	0.00	0.01	0.01	0.00	0.01	0.01	0.04	0.09	0.13	0.17	0.19

Table 5.3-PSN4 Crack Widths in Beam PSN4-WDH

STATION	APPLIED SHEAR (KN)	75.0	90.0	97.5	105.0	112.5	120.0	135.0	150.0	165.0	180.0	195.0	202.5
		SIDE B											
		Crack Widths (mm)											
2	w	0.00	0.00	0.00	0.00	0.00	0.00	0.02	0.05	0.06	0.06	0.05	0.04
3	w	0.00	0.00	0.00	0.00	0.00	0.00	0.06	0.08	0.11	0.18	0.25	0.30
4	w	0.00	0.00	0.00	0.01	0.05	0.09	0.13	0.15	0.18	0.19	0.23	0.26
5	w	0.00	0.00	0.00	0.02	0.06	0.07	0.11	0.16	0.19	0.22	0.28	0.29
6	w	0.00	0.03	0.03	0.07	0.10	0.13	0.15	0.19	0.25	0.27	0.32	0.35
7	w	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
8	w	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
9	w	0.00	0.00	0.00	0.00	0.01	0.05	0.17	0.23	0.31	0.37	0.45	0.50
9A	w	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.01
	w	0.00	0.00	0.00	0.00	0.00	0.00	0.39	0.60	0.84	1.05	1.41	1.52
	w1	0.00	0.00	0.00	0.00	0.00	0.00	0.27	0.42	0.59	0.76	1.03	1.01
11	w2	0.00	0.00	0.00	0.00	0.00	0.00	0.34	0.53	0.75	0.94	1.27	1.37
	w3	0.00	0.00	0.00	0.00	0.00	0.00	0.41	0.64	0.90	1.12	1.51	1.76
	w	0.00	0.00	0.00	0.00	0.00	0.00	0.62	0.87	1.18	1.52	1.99	2.30
	w1	0.00	0.00	0.00	0.00	0.00	0.00	0.53	0.76	1.02	1.30	1.73	2.00
12	w2	0.00	0.00	0.00	0.00	0.00	0.00	0.57	0.81	1.10	1.41	1.85	2.14
	w3	0.00	0.00	0.00	0.00	0.00	0.00	0.61	0.86	1.19	1.56	2.02	2.34
	w	0.00	0.00	0.00	0.00	0.11	0.28	0.70	0.96	1.22	1.47	1.83	2.06
	w1	0.00	0.00	0.00	0.00	0.12	0.24	0.26	0.32	0.38	0.39	0.41	0.42
13	w2	0.00	0.00	0.00	0.00	0.10	0.27	0.68	0.92	1.18	1.43	1.79	2.03
	w3	0.00	0.00	0.00	0.00	0.07	0.25	0.77	1.06	1.37	1.70	2.15	2.45
	w	0.00	0.02	0.04	0.09	0.15	0.17	0.21	0.23	0.26	0.28	0.30	0.31
	w1	0.00	0.01	0.03	0.06	0.07	0.08	0.09	0.11	0.14	0.16	0.17	0.17
14	w2	0.00	0.03	0.06	0.14	0.32	0.37	0.44	0.46	0.49	0.51	0.55	0.56
	w3	0.00	0.01	0.03	0.07	0.11	0.14	0.17	0.18	0.21	0.23	0.25	0.26
	w	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	w1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
15	w2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	w3	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	w	0.00	0.00	0.00	0.00	0.00	0.00	0.67	0.67	0.96	1.28	1.72	2.02
	w1	0.00	0.00	0.00	0.00	0.00	0.00	0.52	0.61	0.88	1.19	1.60	1.87
16	w2	0.00	0.00	0.00	0.00	0.00	0.00	0.51	0.62	0.90	1.21	1.62	1.90
	w3	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.61	0.90	1.21	1.63	1.91
	w	0.00	0.00	0.00	0.04	0.16	0.31	0.72	0.98	1.23	1.52	1.89	2.14
	w1	0.00	0.00	0.00	0.00	0.10	0.25	0.52	0.70	0.86	1.05	1.30	1.46
17	w2	0.00	0.00	0.00	0.06	0.16	0.30	0.68	0.92	1.15	1.42	1.76	2.00
	w3	0.00	0.00	0.00	0.01	0.13	0.29	0.72	0.99	1.26	1.56	1.94	2.21
	w	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	w1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
18	w2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	w3	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Table 5.3-PSN5 Crack Widths in Beam PSN5-S6M

STATION	APPLIED SHEAR(KN)	75.0	90.0	97.5	105.0	120.0	135.0	150.0	165.0	180.0	195.0	210.0
		SIDE A — Crack Widths (mm)										
2	w	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.06	0.10	0.14	0.18
3	w	0.00	0.00	0.00	0.00	0.03	0.09	0.10	0.13	0.16	0.20	0.23
4	w	0.00	0.00	0.00	0.00	0.07	0.11	0.15	0.21	0.23	0.26	0.31
5	w	0.00	0.03	0.05	0.08	0.15	0.22	0.24	0.30	0.32	0.35	0.41
6	w	0.02	0.05	0.08	0.12	0.16	0.22	0.26	0.30	0.33	0.52	0.42
7	w	0.00	0.00	0.00	0.13	0.00	0.00	0.00	0.00	0.00	0.00	0.00
8	w	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
9	w	0.00	0.00	0.00	0.00	0.02	0.10	0.00	0.22	0.28	0.37	0.45
9A	w	0.00	0.00	0.00	0.00	0.03	0.05	0.06	0.07	0.08	0.10	0.11
10	w	0.00	0.04	0.06	0.08	0.11	0.16	0.19	0.23	0.27	0.30	0.35
	w	0.00	0.00	0.00	0.00	0.00	0.24	0.43	0.76	1.04	1.35	1.69
	w1	0.00	0.00	0.00	0.00	0.00	0.13	0.24	0.43	0.59	0.75	0.91
11	w2	0.00	0.00	0.00	0.00	0.00	0.21	0.37	0.66	0.90	1.17	1.47
	w3	0.00	0.00	0.00	0.00	0.00	0.27	0.47	0.87	1.20	1.59	2.03
	w	0.00	0.00	0.00	0.00	0.27	0.58	0.90	1.22	1.78	2.28	2.75
	w1	0.00	0.00	0.00	0.00	0.14	0.28	0.72	1.00	1.35	1.80	2.30
12	w2	0.00	0.00	0.00	0.00	0.23	0.53	0.85	1.14	1.65	2.13	2.60
	w3	0.00	0.00	0.00	0.00	0.31	0.68	0.91	1.21	1.84	2.34	2.79
	w	0.00	0.00	0.00	0.00	0.39	0.79	1.08	1.52	1.92	2.41	3.00
	w1	0.00	0.00	0.00	0.00	0.31	0.58	0.79	1.12	1.42	1.75	2.05
13	w2	0.00	0.00	0.00	0.00	0.37	0.73	0.99	1.40	1.77	2.21	2.73
	w3	0.00	0.00	0.00	0.00	0.38	0.81	1.11	1.57	2.00	2.52	3.20
	w	0.00	0.00	0.00	0.08	0.16	0.21	0.25	0.31	0.33	0.38	0.42
	w1	0.00	0.00	0.00	0.05	0.14	0.18	0.21	0.19	0.30	0.35	0.39
14	w2	0.00	0.00	0.00	0.08	0.15	0.20	0.24	0.34	0.33	0.37	0.41
	w3	0.00	0.00	0.00	0.05	0.13	0.17	0.21	0.26	0.30	0.34	0.39
	w	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	w1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
15	w2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	w3	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	w	0.00	0.00	0.00	0.00	0.18	0.57	0.82	1.20	1.56	1.99	1.48
	w1	0.00	0.00	0.00	0.00	0.00	0.19	0.31	0.49	0.65	0.88	1.19
16	w2	0.00	0.00	0.00	0.00	0.21	0.52	0.74	1.08	1.40	1.79	1.19
	w3	0.00	0.00	0.00	0.00	0.36	0.79	1.09	1.56	2.01	2.52	0.14
	w	0.00	0.00	0.00	0.00	0.30	0.61	0.82	1.15	1.44	1.79	2.17
	w1	0.00	0.00	0.00	0.00	0.22	0.50	0.70	0.99	1.29	1.61	1.97
17	w2	0.00	0.00	0.00	0.00	0.28	0.57	0.78	1.09	1.38	1.72	2.09
	w3	0.00	0.00	0.00	0.00	0.30	0.60	0.82	1.14	1.43	1.78	2.15
	w	0.00	0.00	0.00	0.05	0.13	0.17	0.21	0.26	0.30	0.34	0.38
	w1	0.00	0.00	0.00	0.04	0.11	0.15	0.19	0.23	0.26	0.30	0.33
18	w2	0.00	0.00	0.00	0.05	0.12	0.16	0.19	0.23	0.27	0.31	0.34
	w3	0.00	0.00	0.00	0.04	0.11	0.14	0.18	0.22	0.25	0.29	0.33

Table 5.3-PSN5 Crack Widths in Beam PSN5-S6M

STATION	APPLIED SHEAR(KN)	75.0	90.0	97.5	105.0	120.0	135.0	150.0	165.0	180.0	195.0	210.0
		SIDE B										
		Crack Widths (mm)										
2	w	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.04	0.05	0.10
3	w	0.00	0.00	0.00	0.00	0.00	0.04	0.10	0.13	0.17	0.21	0.25
4	w	0.00	0.00	0.00	0.02	0.07	0.00	0.21	0.25	0.30	0.29	0.41
5	w	0.00	0.00	0.00	0.01	0.08	0.12	0.16	0.20	0.24	0.28	0.32
6	w	0.01	0.05	0.08	0.13	0.00	0.01	0.25	0.29	0.34	0.38	0.43
7	w	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
8	w	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
9	w	0.00	0.00	0.00	0.00	0.00	0.03	0.11	0.19	0.27	0.37	0.47
9A	w	0.00	0.00	0.00	0.00	0.04	0.10	0.08	0.29	0.08	0.07	0.06
	w	0.00	0.00	0.00	0.00	0.00	0.17	0.46	0.78	1.11	0.84	1.89
	w1	0.00	0.00	0.00	0.00	0.00	0.09	0.37	0.51	0.79	0.08	1.28
11	w2	0.00	0.00	0.00	0.00	0.00	0.14	0.43	0.68	1.00	0.82	1.66
	w3	0.00	0.00	0.00	0.00	0.00	0.23	0.46	0.93	1.20	1.73	2.18
	w	0.00	0.00	0.00	0.00	0.00	0.51	0.86	1.24	1.63	2.07	2.55
	w1	0.00	0.00	0.00	0.00	0.00	0.39	0.71	1.03	1.38	1.78	2.19
12	w2	0.00	0.00	0.00	0.00	0.00	0.47	0.81	1.17	1.53	1.96	2.41
	w3	0.00	0.00	0.00	0.00	0.00	0.50	0.86	1.23	1.62	2.06	2.53
	w	0.00	0.00	0.00	0.00	0.25	0.49	0.76	1.04	1.27	1.52	1.65
	w1	0.00	0.00	0.00	0.00	0.23	0.33	0.34	0.42	0.48	0.42	0.28
13	w2	0.00	0.00	0:00	0.00	0.23	0.45	0.71	0.98	1.21	1.45	1.62
	w3	0.00	0.00	0.00	0.00	0.28	0.51	0.94	1.35	1.72	2.18	2.56
	w	0.00	0.00	0.00	0.00	0.21	0.24	0.27	0.28	0:30	0.32	0.34
	w1	0.00	0.00	0.00	0.00	0.11	0.16	0.18	0.20	0.22	0.24	0.26
14	w2	0.00	0.00	0.00	0.00	0.20	0.23	0.26	0.27	0.29	0.31	0.33
	w3	0.00	0.00	0.00	0.00	0.17	0.20	0.24	0.24	0.26	0.28	0.31
	w	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	w1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
15	w2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	w3	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	w	0.00	0.00	0.00	0.00	0.00	0.25	0.76	1.21	1.67	2.00	2.44
	w1	0.00	0.00	0.00	0.00	0.00	0.09	0.41	0.89	1.41	1.61	1.97
16	w2	0.00	0.00	0.00	0.00	0.00	0.23	0.71	1.12	1.55	1.87	2.29
	w3	0.00	0.00	0.00	0.00	0.00	0.31	0.90	1.26	1.64	2.05	2.51
	w	0.00	0.00	0.00	0.00	0.00	0.52	0.83	1.26	1.08	1.96	2.34
	w1	0.00	0.00	0.00	0.00	0.00	0.22	0.41	0.80	0.12	1.25	1.63
17	w2	0.00	0.00	0.00	0.00	0.00	0.48	0.76	1.13	1.05	1.77	2.14
	w3	0.00	0.00	0.00	0.00	0.00	0.65	1.00	1.35	1.72	2.12	2.49
	w	0.00	0.00	0.01	0.05	0.16	0.24	0.25	0.26	0.37	0.27	0.28
	w1	0.00	0.00	0.01	0.03	0.12	0.19	0.21	0.22	0.36	0.23	0.24
18	w2	0.00	0.00	0.02	0.06	0.15	0.23	0.24	0.25	0.24	0.26	0.28
	w3	0.00	0.00	0.01	0.03	0.13	0.21	0.22	0.23	0.23	0.24	0.26

Table 5.3-PSN6 Crack Widths in Beam PSN6-WS

STATION	APPLIED SHEAR (KN)	75.0	90.0	97.5	105.0	112.5	120.0	135.0	150.0	165.0	180.0	195.0	210.0
		SIDE A — Crack Widths (mm)											
2	w	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.02	0.05	0.09	0.13	0.17
3	w	0.00	0.00	0.00	0.00	0.00	0.02	0.07	0.08	0.11	0.14	0.17	0.20
4	w	0.00	0.00	0.02	0.04	0.06	0.13	0.16	0.20	0.24	0.28	0.31	0.36
5	w	0.00	0.00	0.01	0.04	0.07	0.10	0.12	0.16	0.18	0.21	0.23	0.25
6	w	0.02	0.05	0.08	0.10	0.12	0.14	0.17	0.20	0.24	0.27	0.30	0.34
7	w	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
8	w	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
9	w	0.00	0.00	0.00	0.00	0.00	0.00	0.02	0.06	0.12	0.18	0.23	0.29
9A	w	0.00	0.00	0.00	0.00	0.01	0.06	0.08	0.09	0.10	0.11	0.11	0.13
10	w	0.02	0.05	0.07	0.09	0.11	0.13	0.17	0.21	0.24	0.27	0.31	0.34
	w	0.00	0.00	0.00	0.00	0.00	0.01	0.09	0.23	0.35	0.48	0.59	0.70
	w1	0.00	0.00	0.00	0.00	0.00	0.00	0.04	0.15	0.22	0.31	0.37	0.43
11	w2	0.00	0.00	0.00	0.00	0.00	0.01	0.08	0.21	0.31	0.44	0.53	0.63
	w3	0.00	0.00	0.00	0.00	0.00	0.05	0.15	0.35	0.51	0.72	0.89	1.09
	w	0.00	0.00	0.00	0.00	0.00	0.09	0.44	0.69	0.93	1.22	1.52	1.85
	w1	0.00	0.00	0.00	0.00	0.00	0.00	0.24	0.38	0.53	0.79	1.03	1.31
12	w2	0.00	0.00	0.00	0.00	0.00	0.15	0.39	0.61	0.84	1.12	1.40	1.70
	w3	0.00	0.00	0.00	0.00	0.00	0.27	0.57	0.85	1.10	1.40	1.71	2.05
	w	0.00	0.00	0.00	0.00	0.08	0.32	0.58	0.82	1.08	1.43	1.75	2.12
	w1	0.00	0.00	0.00	0.00	0.02	0.19	0.43	0.65	0.81	1.00	1.28	1.39
13	w2	0.00	0.00	0.00	0.00	0.07	0.29	0.54	0.78	1.02	1.34	1.65	1.98
	w3	0.00	0.00	0.00	0.00	0.09	0.30	0.57	0.81	1.08	1.46	1.77	2.20
	w	0.00	0.00	0.00	0.08	0.16	0.26	0.29	0.33	0.37	0.43	0.48	0.54
	w1	0.00	0.00	0.00	0.03	0.12	0.21	0.25	0.28	0.31	0.35	0.39	0.43
14	w2	0.00	0.00	0.00	0.08	0.15	0.25	0.29	0.33	0.37	0.42	0.48	0.53
	w3	0.00	0.00	0.00	0.04	0.13	0.23	0.26	0.30	0.34	0.39	0.45	0.50
	w	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	w1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
15	w2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	w3	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	w	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	w1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
16	w2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	w3	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	w	0.00	0.00	0.00	0.00	0.00	0.19	0.43	0.64	0.85	1.11	1.36	1.63
	w1	0.00	0.00	0.00	0.00	0.00	0.05	0.25	0.43	0.61	0.83	1.04	1.27
17	w2	0.00	0.00	0.00	0.00	0.00	0.17	0.40	0.60	0.80	1.05	1.30	1.55
	w3	0.00	0.00	0.00	0.00	0.00	0.21	0.44	0.66	0.87	1.13	1.39	1.66
	w	0.00	0.02	0.05	0.05	0.12	0.28	0.31	0.34	0.37	0.40	0.43	0.48
	w1	0.00	0.01	0.03	0.00	0.00	0.20	0.24	0.26	0.29	0.32	0.34	0.37
18	w2	0.00	0.06	0.10	0.12	0.17	0.28	0.31	0.34	0.37	0.40	0.44	0.48
	w3	0.00	0.01	0.03	0.11	0.12	0.24	0.28	0.30	0.33	0.36	0.39	0.44

Table 5.3-PSN6 Crack Widths in Beam PSN6-WS

STATION	APPLIED SHEAR(KN)	75.0	90.0	97.5	105.0	112.5	120.0	135.0	150.0	165.0	180.0	195.0	210.0
							SIDE B Crack Widths (mm)						
2	w	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.03	0.04	0.06	0.08
3	w	0.00	0.00	0.00	0.00	0.00	0.01	0.10	0.14	0.17	0.20	0.24	0.29
4	w	0.00	0.00	0.00	0.01	0.02	0.09	0.10	0.18	0.23	0.24	0.31	0.35
5	w	0.00	0.00	0.00	0.02	0.06	0.09	0.13	0.16	0.19	0.22	0.25	0.28
6	w	0.01	0.03	0.03	0.07	0.08	0.10	0.13	0.17	0.20	0.23	0.26	0.30
7	w	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
8	w	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
9	w	0.00	0.00	0.00	0.00	0.00	0.05	0.13	0.20	0.26	0.34	0.42	0.51
9A	w	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	w	0.00	0.00	0.00	0.00	0.00	0.00	0.28	0.58	0.78	1.01	1.27	1.65
	w1	0.00	0.00	0.00	0.00	0.00	0.00	0.15	0.35	0.49	0.64	0.83	1.13
11	w2	0.00	0.00	0.00	0.00	0.00	0.00	0.24	0.51	0.69	0.90	1.14	1.50
	w3	0.00	0.00	0.00	0.00	0.00	0.00	0.32	0.64	0.83	1.07	1.34	1.73
	w	0.00	0.00	0.00	0.00	0.00	0.17	0.54	0.87	1.14	1.43	1.77	2.22
	w1	0.00	0.00	0.00	0.00	0.00	0.07	0.43	0.72	0.94	1.18	1.46	1.83
12	w2	0.00	0.00	0.00	0.00	0.00	0.15	0.50	0.82	1.07	1.35	1.67	2.08
	w3	0.00	0.00	0.00	0.00	0.00	0.16	0.53	0.86	1.14	1.44	1.79	2.23
	w	0.00	0.00	0.00	0.00	0.00	0.34	0.75	0.89	0.83	0.79	0.80	0.81
	w1	0.00	0.00	0.00	0.00	0.00	0.23	0.49	0.63	0.58	0.53	0.53	0.50
13	w2	0.00	0.00	0.00	0.00	0.00	0.31	0.69	0.83	0.77	0.73	0.74	0.75
	w3	0.00	0.00	0.00	0.00	0.00	0.32	0.75	0.88	0.82	0.79	0.80	0.83
	w	0.00	0.00	0.00	0.00	0.10	0.13	0.13	0.15	0.16	0.19	0.20	0.23
	w1	0.00	0.00	0.00	0.00	0.06	0.06	0.06	0.08	0.10	0.12	0.14	0.16
14	w2	0.00	0.00	0.00	0.00	0.11	0.14	0.14	0.16	0.16	0.19	0.21	0.24
	w3	0.00	0.00	0.00	0.00	0.07	0.09	0.09	0.11	0.12	0.14	0.16	0.18
	w	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	w1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
15	w2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	w3	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	w	0.00	0.00	0.00	0.00	0.00	0.15	0.41	0.75	1.03	1.08	1.65	2.07
	w1	0.00	0.00	0.00	0.00	0.00	0.11	0.39	0.62	0.80	0.91	1.40	1.78
16	w2	0.00	0.00	0.00	0.00	0.00	0.02	0.38	0.69	0.95	1.01	1.54	1.93
	w3	0.00	0.00	0.00	0.00	0.00	0.08	0.36	0.73	1.04	1.06	1.63	2.02
	w	0.00	0.00	0.00	0.00	0.07	0.34	0.66	0.92	1.17	1.43	1.71	2.04
	w1	0.00	0.00	0.00	0.00	0.00	0.20	0.51	0.71	0.82	0.95	1.12	1.32
17	w2	0.00	0.00	0.00	0.00	0.11	0.33	0.63	0.88	1.11	1.37	1.64	1.96
	w3	0.00	0.00	0.00	0.00	0.06	0.31	0.64	0.90	1.15	1.43	1.72	2.07
	w	0.00	0.00	0.01	0.03	0.07	0.20	0.34	0.44	0.44	0.44	0.43	0.43
	w1	0.00	0.00	0.01	0.03	0.07	0.05	0.04	0.14	0.04	0.15	0.15	0.06
18	w2	0.00	0.00	0.00	0.01	0.05	0.27	0.52	0.59	0.69	0.60	0.57	0.65
	w3	0.00	0.00	0.01	0.03	0.07	0.16	0.30	0.39	0.40	0.40	0.38	0.39

Table 5.4-PSN1 Slides in Beam PSN1-0

STATION	APPLIED SHEAR (KN)	SIDE A 75.0	90.0	105.0	112.0	120.0	127.5	135.0	142.5
		Slides (mm)							
	s	0.00	0.00	0.00	0.01	0.00	0.01	-0.01	-0.02
	s1	0.00	0.00	0.00	0.13	0.21	0.25	0.29	0.33
11	s2	0.00	0.00	0.00	-0.30	-0.40	-0.48	-0.54	-0.60
	s3	0.00	0.00	0.00	0.21	0.33	0.39	0.45	0.52
	s	0.00	0.00	0.00	-0.07	-0.13	-0.19	-0.24	-0.27
	s1	0.00	0.00	0.00	0.17	0.23	0.25	0.28	0.32
12	s2	0.00	0.00	0.00	0.01	0.24	0.04	0.05	0.06
	s3	0.00	0.00	0.00	0.23	0.20	0.34	0.37	0.42
	s	0.00	0.00	0.04	0.29	0.46	0.57	0.66	0.76
	s1	0.00	0.00	0.01	0.43	0.64	0.77	0.89	1.00
13	s2	0.00	0.00	-0.03	0.04	0.06	0.09	0.12	0.14
	s3	0.00	0.00	0.05	0.69	1.03	1.22	1.40	1.59
	s	0.00	0.00	0.01	0.12	0.11	0.10	0.09	0.09
	s1	0.00	0.00	-0.03	0.12	0.11	0.11	0.11	0.11
14	s2	0.00	0.00	-0.06	0.05	0.04	0.04	0.04	0.04
	s3	0.00	0.00	-0.03	0.18	0.18	0.17	0.17	0.18
	s	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	s1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
15	s2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	s3	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	s	0.00	0.00	0.00	0.17	0.27	0.32	0.36	0.40
	s1	0.00	0.00	0.00	0.26	0.41	0.50	0.58	0.66
16	s2	0.00	0.00	0.00	-0.11	-0.12	-0.14	-0.15	-0.16
	s3	0.00	0.00	0.00	0.41	0.64	0.76	0.88	0.99
	s	0.00	0.00	0.00	-0.02	-0.11	-0.15	-0.19	-0.24
	s1	0.00	0.00	0.00	0.13	0.16	0.19	0.20	0.21
17	s2	0.00	0.00	0.00	-0.12	-0.12	-0.10	-0.10	-0.12
	s3	0.00	0.00	0.00	0.26	0.31	0.34	0.37	0.39
	s	0.00	0.02	0.04	0.01	-0.05	0.02	0.02	0.02
	s1	0.00	-0.00	0.00	0.10	0.11	0.11	0.12	0.13
18	s2	0.00	-0.00	-0.01	0.08	0.20	0.10	0.11	0.12
	s3	0.00	-0.00	0.01	0.10	-0.09	0.11	0.12	0.12

Table 5.4-PSN1 Slides in Beam PSN1-0

STATION	APPLIED SHEAR(KN)	75.0	90.0	105.0	112.0	120.0	127.5	135.0	142.5
					SIDE B				
					Slides (mm)				
	s	0.00	0.00	0.00	0.00	-0.01	-0.00	-0.01	-0.01
	s1	0.00	0.00	0.00	0.20	0.28	0.35	0.41	0.49
11	s2	0.00	0.00	0.00	-0.29	-0.38	-0.43	-0.49	-0.55
	s3	0.00	0.00	0.00	0.30	0.42	0.50	0.59	0.70
	s	0.00	0.00	-0.03	-0.16	-0.24	-0.27	-0.31	1.86
	s1	0.00	0.00	0.10	0.27	0.32	0.39	0.45	5.64
12	s2	0.00	0.00	-0.14	0.01	0.04	0.08	0.12	-0.67
	s3	0.00	0.00	0.18	0.35	0.41	0.49	0.56	7.92
	s	0.00	0.00	0.35	1.15	1.52	1.79	2.08	13.63
	s1	0.00	0.00	0.43	1.32	1.73	2.03	2.35	14.17
13	s2	0.00	0.00	0.35	0.99	1.31	1.53	1.79	9.25
	s3	0.00	0.00	0.49	1.69	2.20	2.59	2.99	20.01
	s	0.00	0.02	0.01	0.01	0.01	0.03	0.03	0.02
	s1	0.00	-0.00	-0.01	-0.01	-0.01	-0.01	-0.01	-0.02
14	s2	0.00	-0.00	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01
	s3	0.00	-0.00	-0.01	-0.01	-0.01	-0.01	-0.01	-0.02
	s	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	s1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
15	s2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	s3	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	s	0.00	0.00	0.26	0.35	0.42	0.47	0.52	7.35
	s1	0.00	0.00	0.05	0.43	0.61	0.75	0.89	1.06
16	s2	0.00	0.00	-0.60	-0.62	-0.61	-0.58	-0.54	-20.64
	s3	0.00	0.00	0.31	0.83	1.08	1.26	1.44	8.99
	s	0.00	0.00	0.17	0.54	0.71	0.85	1.01	11.15
	s1	0.00	0.00	0.28	0.83	1.10	1.29	1.52	12.55
17	s2	0.00	0.00	0.23	0.77	1.01	1.20	1.42	7.65
	s3	0.00	0.00	0.31	0.88	1.16	1.36	1.60	17.44
	s	0.00	0.02	0.03	0.02	0.03	0.03	0.04	0.04
	s1	0.00	0.00	-0.01	-0.02	-0.02	-0.03	-0.03	-0.04
18	s2	0.00	-0.01	-0.03	-0.03	-0.04	-0.05	-0.05	-0.06
	s3	0.00	0.00	-0.01	-0.02	-0.02	-0.02	-0.01	-0.02

Table 5.4-PSN2 Slides in Beam PSN2-WD

STATION	APPLIED SHEAR (KN)	75.0	90.0	97.5	105.0	112.5	120.0	135.0	150.0	165.0	180.0	195.0	202.5
		SIDE A, Slides (mm)											
11	s	0.00	0.00	0.00	0.00	0.00	0.05	0.12	0.11	0.10	0.10	0.11	0.16
	s1	0.00	0.00	0.00	0.00	0.00	0.01	0.11	0.17	0.28	0.24	0.29	0.34
	s2	0.00	0.00	0.00	0.00	0.00	-0.04	-0.08	-0.09	0.11	-0.11	-0.10	-0.13
	s3	0.00	0.00	0.00	0.00	0.00	0.04	0.22	0.30	0.36	0.42	0.50	0.60
12	s	0.00	0.00	0.00	0.00	-0.02	-0.03	-0.05	-0.09	-0.10	-0.09	-0.09	-0.11
	s1	0.00	0.00	0.00	0.00	0.01	0.02	0.04	0.07	0.10	0.15	0.21	0.24
	s2	0.00	0.00	0.00	0.00	-0.14	-0.14	-0.19	-0.24	-0.28	-0.32	-0.34	-0.36
	s3	0.00	0.00	0.00	0.00	0.05	0.09	0.14	0.22	0.29	0.38	0.49	0.55
13	s	0.00	0.00	0.00	0.04	0.15	0.19	0.25	0.22	0.19	0.19	0.19	0.20
	s1	0.00	0.00	0.00	0.01	0.13	0.20	0.27	0.23	0.19	0.17	0.17	0.17
	s2	0.00	0.00	0.00	-0.02	0.06	0.10	0.19	0.15	0.09	0.07	0.06	0.06
	s3	0.00	0.00	0.00	0.02	0.22	0.34	0.37	0.34	0.31	0.31	0.32	0.33
14	s	0.00	0.00	0.01	-0.01	-0.00	-0.02	-0.03	-0.05	-0.07	-0.06	-0.08	-0.10
	s1	0.00	0.00	-0.01	0.02	0.02	0.02	0.01	0.01	-0.00	-0.00	0.00	-0.00
	s2	0.00	0.00	-0.03	0.01	0.01	0.01	0.00	0.00	-0.00	-0.01	-0.00	-0.00
	s3	0.00	0.00	-0.01	0.00	0.01	-0.01	-0.01	-0.02	-0.03	-0.02	-0.02	-0.03
15	s	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	s1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	s2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	s3	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
16	s	0.00	0.00	0.00	0.00	0.00	0.00	0.09	0.04	-0.08	-0.16	-0.23	-0.27
	s1	0.00	0.00	0.00	0.00	0.00	0.00	0.19	0.17	0.14	0.13	0.15	0.16
	s2	0.00	0.00	0.00	0.00	0.00	0.00	0.09	0.07	0.04	0.02	0.02	0.03
	s3	0.00	0.00	0.00	0.00	0.00	0.00	0.24	0.22	0.18	0.18	0.21	0.23
17	s	0.00	0.00	0.00	0.03	-0.02	-0.05	-0.03	0.11	0.25	0.37	0.53	0.62
	s1	0.00	0.00	0.00	0.02	0.04	0.05	0.10	0.21	0.34	0.46	0.60	0.70
	s2	0.00	0.00	0.00	0.01	0.02	0.02	0.02	0.02	0.02	0.04	0.07	0.09
	s3	0.00	0.00	0.00	0.01	0.04	0.05	0.14	0.35	0.60	0.79	1.04	1.19
18	s	0.00	0.00	-0.03	-0.04	-0.04	-0.03	-0.04	-0.03	-0.05	-0.07	-0.09	-0.09
	s1	0.00	0.00	-0.02	-0.02	0.02	0.04	0.04	0.05	0.04	0.04	0.04	0.04
	s2	0.00	0.00	-0.01	-0.02	0.03	0.05	0.06	0.07	0.07	0.07	0.08	0.08
	s3	0.00	0.00	-0.03	-0.04	-0.01	-0.00	-0.00	-0.00	-0.01	-0.02	-0.03	-0.03

Table 5.4-PSN2 Slides in Beam PSN2-WD

STATION	APPLIED SHEAR(KN)	75.0	90.0	97.5	105.0	112.5	120.0	135.0	150.0	165.0	180.0	195.0	202.5
		SIDE B											
		Slides (mm)											
	s	0.00	0.00	0.00	0.00	0.00	0.00	-0.02	-0.02	-0.15	-0.27	-0.38	-0.44
	s1	0.00	0.00	0.00	0.00	0.00	0.00	0.06	-0.02	0.01	-0.02	-0.03	-0.03
11	s2	0.00	0.00	0.00	0.00	0.00	0.00	-0.17	-0.45	-0.24	-0.30	-0.34	-0.36
	s3	0.00	0.00	0.00	0.00	0.00	0.00	0.12	0.09	0.06	0.04	0.05	0.05
	s	0.00	0.00	0.00	0.00	-0.05	-0.09	-0.13	-0.11	-0.14	0.08	0.34	0.32
	s1	0.00	0.00	0.00	0.00	-0.01	-0.01	0.01	0.06	0.11	0.25	0.42	0.52
12	s2	0.00	0.00	0.00	0.00	-0.10	-0.10	-0.17	-0.20	-0.01	0.50	0.68	0.79
	s3	0.00	0.00	0.00	0.00	0.02	0.02	0.08	0.16	0.15	0.13	0.13	0.13
	s	0.00	0.00	-0.00	0.01	0.10	0.13	0.13	0.13	0.12	0.11	0.11	0.12
	s1	0.00	0.00	0.00	0.05	0.17	0.22	0.24	0.23	0.21	0.20	0.21	0.21
13	s2	0.00	0.00	-0.00	-0.03	0.04	0.08	0.12	0.08	0.04	0.02	0.01	0.01
	s3	0.00	0.00	0.00	0.09	0.26	0.32	0.33	0.34	0.34	0.33	0.35	0.37
	s	0.00	0.00	0.03	0.01	0.01	-0.00	-0.01	-0.01	-0.02	-0.02	-0.02	-0.03
	s1	0.00	0.00	-0.02	-0.01	-0.02	-0.02	-0.03	-0.03	-0.03	-0.03	-0.03	-0.03
14	s2	0.00	0.00	-0.04	-0.03	-0.04	-0.04	-0.05	-0.05	-0.06	-0.06	-0.07	-0.07
	s3	0.00	0.00	-0.02	-0.02	-0.03	-0.03	-0.03	-0.02	-0.02	-0.02	-0.00	-0.01
	s	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.15	0.22	0.30	0.35
	s1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.17	0.28	0.43	0.51
15	s2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.17	0.13	0.09	0.09
	s3	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.19	0.37	0.59	0.71
	s	0.00	0.00	0.00	0.00	0.00	0.00	0.02	-0.09	-0.18	-0.31	-0.38	-0.42
	s1	0.00	0.00	0.00	0.00	0.00	0.00	0.17	0.13	0.07	0.06	0.10	0.12
16	s2	0.00	0.00	0.00	0.00	0.00	0.00	-0.08	-0.12	-0.17	-0.17	-0.16	-0.15
	s3	0.00	0.00	0.00	0.00	0.00	0.00	0.26	0.21	0.15	0.14	0.18	0.22
	s	0.00	0.00	0.00	0.02	-0.02	-0.05	-0.03	0.09	0.18	0.23	0.23	0.30
	s1	0.00	0.00	0.00	0.04	0.06	0.07	0.12	0.22	0.34	0.43	0.46	0.51
17	s2	0.00	0.00	0.00	0.02	0.01	0.05	0.00	-0.01	-0.03	0.11	0.20	0.26
	s3	0.00	0.00	0.00	0.05	0.09	0.08	0.19	0.36	0.58	0.64	0.63	0.67
	s	0.00	0.00	0.01	0.05	0.04	0.05	0.05	0.05	0.05	0.06	0.07	0.08
	s1	0.00	0.00	-0.01	0.02	0.03	0.03	0.04	0.04	0.05	0.05	0.06	0.07
18	s2	0.00	0.00	-0.02	0.01	0.01	0.02	0.02	0.02	0.03	0.04	0.04	0.04
	s3	0.00	0.00	-0.01	0.03	0.03	0.04	0.05	0.06	0.06	0.08	0.10	0.11

Table 5.4-PSN3 Slides in Beam PSN3-D2

	APPLIED	SIDE A											
STATION	SHEAR(KN)	75.0	90.0	97.5	105.0	112.5	120.0	135.0	150.0	165.0	180.0	195.0	210.0
		Slides (mm)											
	s	0.00	0.00	0.00	0.00	0.00	0.03	0.07	0.09	0.17	0.04	-0.02	-0.01
	s1	0.00	0.00	0.00	0.00	0.00	0.03	0.10	0.14	0.22	0.17	0.19	0.24
11	s2	0.00	0.00	0.00	0.00	0.00	-0.08	-0.08	-0.09	-0.12	-0.16	-0.19	-0.20
	s3	0.00	0.00	0.00	0.00	0.00	0.08	0.19	0.26	0.41	0.35	0.40	0.48
	s	0.00	0.00	0.00	0.00	0.04	-0.04	-0.07	-0.04	-0.05	0.02	0.13	0.24
	s1	0.00	0.00	0.00	0.00	0.02	0.06	0.07	0.10	0.14	0.28	0.44	0.61
12	s2	0.00	0.00	0.00	0.00	-0.11	-0.13	-0.16	-0.19	-0.27	-0.21	-0.22	-0.22
	s3	0.00	0.00	0.00	0.00	0.07	0.14	0.18	0.22	0.34	0.52	0.76	1.01
	s	0.00	0.00	0.00	-0.04	-0.06	-0.07	-0.09	-0.10	-0.10	-0.11	-0.11	-0.13
	s1	0.00	0.00	0.00	-0.03	-0.02	-0.01	-0.03	-0.02	-0.01	0.01	0.02	0.04
13	s2	0.00	0.00	0.00	-0.09	-0.10	-0.08	-0.10	-0.12	-0.11	-0.11	-0.10	-0.09
	s3	0.00	0.00	0.00	-0.01	0.01	0.02	0.01	0.02	0.04	0.07	0.09	0.10
	s	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	s1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
14	s2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	s3	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	s	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	s1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
15	s2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	s3	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	s	0.00	0.00	0.00	0.00	0.00	-0.01	-0.06	-0.09	-0.12	-0.14	-0.16	-0.19
	s1	0.00	0.00	0.00	0.00	0.00	0.05	0.06	0.07	0.10	0.15	0.22	0.29
16	s2	0.00	0.00	0.00	0.00	0.00	0.01	0.01	0.02	0.04	0.07	0.13	0.19
	s3	0.00	0.00	0.00	0.00	0.00	0.07	0.07	0.09	0.13	0.19	0.25	0.34
	s	0.00	0.00	0.00	0.01	0.00	0.09	0.14	0.21	0.32	0.44	0.60	0.76
	s1	0.00	0.00	0.00	0.04	0.07	0.15	0.23	0.31	0.42	0.57	0.74	0.94
17	s2	0.00	0.00	0.00	0.01	0.04	-0.00	-0.00	0.02	0.05	0.10	0.16	0.24
	s3	0.00	0.00	0.00	0.05	0.08	0.26	0.40	0.53	0.72	0.95	1.22	1.50
	s	0.00	0.00	0.04	0.04	0.03	0.03	0.04	0.05	0.05	0.05	0.06	0.06
	s1	0.00	0.00	-0.00	-0.00	-0.00	-0.00	-0.00	-0.00	-0.00	-0.00	-0.00	-0.00
18	s2	0.00	0.00	-0.01	-0.00	-0.00	-0.00	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01
	s3	0.00	0.00	-0.00	-0.00	-0.00	-0.00	-0.00	-0.00	-0.00	0.00	0.01	0.01

Table 5.4-PSN3 Slides in Beam PSN3-D2

	APPLIED	SIDE B											
STATION	SHEAR(KN)	75.0	90.0	97.5	105.0	112.5	120.0	135.0	150.0	165.0	180.0	195.0	210.0
		Slides (mm)											
	s	0.00	0.00	0.00	0.00	0.00	0.00	0.08	0.04	-0.00	-0.03	-0.01	0.03
	s1	0.00	0.00	0.00	0.00	0.00	0.00	0.08	0.12	0.11	0.15	0.20	0.31
11	s2	0.00	0.00	0.00	0.00	0.00	0.00	-0.08	-0.01	-0.13	-0.15	-0.15	-0.19
	s3	0.00	0.00	0.00	0.00	0.00	0.00	0.17	0.18	0.23	0.30	0.39	0.58
	s	0.00	0.00	0.00	0.00	0.00	0.00	0.07	0.04	0.15	0.29	0.46	0.65
	s1	0.00	0.00	0.00	0.00	0.00	0.00	0.14	0.19	0.32	0.49	0.72	0.99
12	s2	0.00	0.00	0.00	0.00	0.00	0.00	0.01	-0.01	0.01	0.06	0.16	0.28
	s3	0.00	0.00	0.00	0.00	0.00	0.00	0.21	0.29	0.49	0.75	1.05	1.41
	s	0.00	0.00	0.00	0.00	-0.02	-0.04	-0.06	-0.08	-0.08	-0.13	-0.12	-0.15
	s1	0.00	0.00	0.00	0.00	-0.02	0.00	.0.02	0.01	0.01	-0.00	0.01	0.00
13	s2	0.00	0.00	0.00	0.00	-0.04	-0.04	-0.01	-0.01	-0.04	-0.04	-0.04	-0.05
	s3	0.00	0.00	0.00	0.00	-0.02	0.01	0.02	0.02	0.03	0.01	0.04	0.03
	s	0.00	0.00	0.00	-0.02	0.14	0.18	0.21	0.22	0.28	0.35	0.40	0.44
	s1	0.00	0.00	0.00	-0.03	-0.03	-0.03	-0.04	-0.05	-0.06	-0.07	-0.08	-0.09
14	s2	0.00	0.00	0.00	-0.01	-0.09	-0.11	-0.13	-0.15	-0.18	-0.21	-0.24	-0.27
	s3	0.00	0.00	0.00	-0.03	0.10	0.14	0.17	0.17	0.22	0.29	0.33	0.37
	s	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	s1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
15	s2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	s3	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	s	0.00	0.00	0.00	0.00	0.00	0.00	-0.02	-0.05	-0.07	-0.07	-0.04	-0.00
	s1	0.00	0.00	0.00	0.00	0.00	0.00	0.05	0.03	0.11	0.18	0.30	0.43
16	s2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	-0.10	0.06	0.07	0.21	0.31
	s3	0.00	0.00	0.00	0.00	0.00	0.00	0.06	0.09	0.12	0.23	0.34	0.49
	s	0.00	0.00	0.00	0.00	-0.02	-0.05	0.07	0.17	0.32	0.52	0.77	1.08
	s1	0.00	0.00	0.00	0.00	0.02	0.03	0.03	0.05	0.07	0.10	0.11	0.13
17	s2	0.00	0.00	0.00	0.00	0.01	0.02	-0.21	-0.33	-0.51	-0.72	-1.04	-1.42
	s3	0.00	0.00	0.00	0.00	0.01	0.02	0.22	0.35	0.54	0.77	1.06	1.40
	s	0.00	0.00	0.00	0.01	0.03	0.03	0.02	0.01	0.03	0.03	0.03	0.01
	s1	0.00	0.00	0.00	-0.00	-0.01	-0.00	-0.01	-0.01	-0.01	0.00	0.01	0.01
18	s2	0.00	0.00	0.00	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01	-0.00	0.00	0.01
	s3	0.00	0.00	0.00	-0.00	-0.01	-0.00	-0.01	-0.01	-0.01	-0.01	-0.00	-0.01

Table 5.4-PSN4 Slides in Beam PSN4-WDH

STATION	APPLIED SHEAR (KN)	75.0	90.0	97.5	105.0	112.5	120.0	135.0	150.0	165.0	180.0	195.0	202.5
		SIDE A											
		Slides (mm)											
	s	0.00	0.00	0.00	0.00	0.00	-0.03	-0.11	-0.19	-0.27	-0.36	-0.48	-0.55
	s1	0.00	0.00	0.00	0.00	0.00	0.02	-0.01	-0.02	-0.03	-0.06	-0.07	-0.07
11	s2	0.00	0.00	0.00	0.00	0.00	-0.06	-0.09	-0.12	-0.14	-0.18	-0.22	-0.24
	s3	0.00	0.00	0.00	0.00	0.00	0.03	0.02	0.00	-0.00	-0.02	-0.02	-0.02
	s	0.00	0.00	0.00	0.00	-0.01	0.03	0.05	0.10	0.18	0.26	0.40	0.49
	s1	0.00	0.00	0.00	0.00	0.01	0.11	0.20	0.29	0.41	0.52	0.72	0.85
12	s2	0.00	0.00	0.00	0.00	-0.02	-0.02	-0.02	-0.02	-0.02	-0.00	0.02	0.03
	s3	0.00	0.00	0.00	0.00	0.02	0.16	0.31	0.44	0.62	0.79	1.08	1.27
	s	0.00	0.00	0.00	0.05	0.05	0.20	0.19	0.17	0.16	0.17	0.22	0.22
	s1	0.00	0.00	0.00	-0.01	0.08	0.24	0.28	0.28	0.28	0.30	0.32	0.34
13	s2	0.00	0.00	0.00	-0.06	-0.06	-0.01	0.09	0.10	0.10	0.11	0.15	0.18
	s3	0.00	0.00	0.00	0.04	0.19	0.44	0.44	0.42	0.42	0.44	0.45	0.46
	s	0.00	0.02	0.01	0.01	0.01	0.01	0.01	0.00	0.02	0.02	0.04	0.06
	s1	0.00	-0.01	-0.02	-0.03	-0.03	-0.03	-0.03	-0.04	-0.04	-0.05	-0.04	-0.03
14	s2	0.00	-0.01	-0.02	-0.04	-0.04	-0.04	-0.04	-0.05	-0.06	-0.07	-0.07	-0.07
	s3	0.00	-0.01	-0.02	-0.03	-0.03	-0.03	-0.03	-0.04	-0.04	-0.02	0.00	0.03
	s	0.00	0.00	0.00	0.00	0.00	0.06	0.13	0.18	0.25	0.32	0.42	0.49
	s1	0.00	0.00	0.00	0.00	0.00	0.09	0.17	0.25	0.33	0.43	0.57	0.67
15	s2	0.00	0.00	0.00	0.00	0.00	0.05	-0.01	-0.02	-0.05	-0.09	-0.12	-0.13
	s3	0.00	0.00	0.00	0.00	0.00	0.12	0.26	0.38	0.52	0.67	0.89	1.04
	s	0.00	0.00	0.00	0.00	0.00	0.08	0.03	-0.03	-0.32	-0.40	-0.49	-0.36
	s1	0.00	0.00	0.00	0.00	0.00	0.14	0.19	0.16	0.00	0.00	0.02	0.18
16	s2	0.00	0.00	0.00	0.00	0.00	0.05	0.03	0.00	-0.00	-0.01	0.01	0.01
	s3	0.00	0.00	0.00	0.00	0.00	0.19	0.26	0.22	-0.00	-0.00	0.02	0.24
	s	0.00	0.00	0.00	-0.01	-0.06	-0.10	0.00	0.15	0.26	0.40	0.61	0.74
	s1	0.00	0.00	0.00	-0.01	0.02	0.05	0.15	0.28	0.43	0.57	0.78	0.93
17	s2	0.00	0.00	0.00	-0.05	-0.02	-0.00	0.01	0.02	0.05	0.09	0.15	0.20
	s3	0.00	0.00	0.00	0.01	0.03	0.07	0.24	0.47	0.70	0.92	1.26	1.48
	s	0.00	0.00	0.00	0.01	0.03	0.02	0.01	0.01	0.03	0.04	0.08	0.09
	s1	0.00	0.00	-0.00	-0.00	-0.00	-0.00	-0.01	-0.02	-0.04	-0.05	-0.07	-0.07
18	s2	0.00	0.00	-0.01	-0.02	-0.01	-0.01	-0.01	-0.04	-0.08	-0.10	-0.14	-0.16
	s3	0.00	0.00	-0.00	0.00	-0.00	-0.00	-0.01	-0.01	0.00	0.01	0.03	0.04

Table 5.4-PSN4 Slides in Beam PSN4-WDH

STATION	APPLIED SHEAR(KN)	75.0	90.0	97.5	105.0	112.5	120.0	135.0	150.0	165.0	180.0	195.0	202.5
		SIDE B											
		Slides (mm)											
	s	0.00	0.00	0.00	0.00	0.00	0.00	0.05	0.09	0.14	0.12	0.15	0.21
	s1	0.00	0.00	0.00	0.00	0.00	0.00	0.13	0.19	0.28	0.31	0.39	0.37
11	s2	0.00	0.00	0.00	0.00	0.00	0.00	-0.04	-0.05	-0.05	-0.08	-0.11	-0.42
	s3	0.00	0.00	0.00	0.00	0.00	0.00	0.19	0.30	0.42	0.48	0.61	0.72
	s	0.00	0.00	0.00	0.00	0.00	0.00	-0.14	-0.20	-0.23	-0.20	-0.27	-0.30
	s1	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.01	0.05	0.13	0.17	0.21
12	s2	0.00	0.00	0.00	0.00	0.00	0.00	-0.10	-0.12	-0.16	-0.16	-0.16	-0.15
	s3	0.00	0.00	0.00	0.00	0.00	0.00	0.04	0.05	0.11	0.23	0.28	0.33
	s	0.00	0.00	0.00	0.00	-0.03	-0.04	0.27	0.44	0.61	0.85	1.17	1.37
	s1	0.00	0.00	0.00	0.00	0.03	0.02	0.00	0.03	0.05	0.04	0.02	0.01
13	s2	0.00	0.00	0.00	0.00	0.05	-0.02	-0.54	-0.75	-0.97	-1.30	-1.76	-2.05
	s3	0.00	0.00	0.00	0.00	-0.01	0.03	0.40	0.62	0.82	1.06	1.38	1.59
	s	0.00	0.01	0.03	0.06	0.23	0.27	0.33	0.33	0.33	0.33	0.36	0.37
	s1	0.00	-0.00	-0.00	-0.02	-0.02	-0.02	-0.02	-0.03	-0.04	-0.04	-0.04	-0.05
14	s2	0.00	-0.00	-0.01	-0.04	-0.09	-0.10	-0.12	-0.12	-0.13	-0.14	-0.15	-0.15
	s3	0.00	-0.00	-0.00	-0.01	0.16	0.19	0.26	0.25	0.24	0.24	0.27	0.28
	s	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	s1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
15	s2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	s3	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	s	0.00	0.00	0.00	0.00	0.00	0.00	0.07	-0.04	-0.10	-0.18	-0.23	-0.27
	s1	0.00	0.00	0.00	0.00	0.00	0.00	0.22	0.11	0.12	0.13	0.18	0.21
16	s2	0.00	0.00	0.00	0.00	0.00	0.00	0.24	0.08	0.08	0.09	0.13	0.15
	s3	0.00	0.00	0.00	0.00	0.00	0.00	-0.02	0.11	0.13	0.14	0.20	0.23
	s	0.00	0.00	0.00	0.05	0.02	-0.06	0.01	0.07	0.17	0.28	0.44	0.56
	s1	0.00	0.00	0.00	0.00	-0.01	-0.00	0.13	0.20	0.32	0.44	0.63	0.75
17	s2	0.00	0.00	0.00	-0.04	-0.06	-0.06	-0.10	-0.11	-0.09	-0.08	-0.03	-0.01
	s3	0.00	0.00	0.00	0.02	0.03	0.03	0.27	0.41	0.59	0.80	1.08	1.28
	s	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	s1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
18	s2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	s3	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Table 5.4-PSN5 Slides in Beam PSN5-S6M

STATION	APPLIED SHEAR(KN)	75.0	90.0	97.5	105.0	120.0	135.0	150.0	165.0	180.0	195.0	210.0
						SIDE A						
						Slides (mm)						
	s	0.00	0.00	0.00	0.00	0.00	0.08	0.15	0.32	0.44	0.62	0.81
	s1	0.00	0.00	0.00	0.00	0.00	0.07	0.14	0.25	0.34	0.43	0.53
11	s2	0.00	0.00	0.00	0.00	0.00	-0.08	-0.10	-0.14	-0.20	-0.30	-0.43
	s3	0.00	0.00	0.00	0.00	0.00	0.15	0.27	0.50	0.69	0.92	1.17
	s	0.00	0.00	0.00	0.00	0.12	0.15	-0.10	0.04	0.03	-0.02	-0.23
	s1	0.00	0.00	0.00	0.00	0.08	0.10	0.08	0.27	0.34	0.37	0.35
12	s2	0.00	0.00	0.00	0.00	-0.08	-0.33	-0.14	0.03	-0.18	-0.19	-0.17
	s3	0.00	0.00	0.00	0.00	0.18	0.33	0.18	0.39	0.62	0.68	0.63
	s	0.00	0.00	0.00	0.00	-0.06	-0.01	0.04	0.10	0.16	0.28	0.57
	s1	0.00	0.00	0.00	0.00	0.02	0.15	0.23	0.35	0.46	0.62	0.88
13	s2	0.00	0.00	0.00	0.00	-0.08	-0.11	-0.12	-0.13	-0.15	-0.17	-0.29
	s3	0.00	0.00	0.00	0.00	0.06	0.28	0.41	0.61	0.79	1.06	1.54
	s	0.00	0.00	0.00	0.02	-0.04	-0.05	-0.05	0.06	-0.07	-0.09	-0.10
	s1	0.00	0.00	0.00	-0.03	-0.01	-0.01	-0.01	-0.12	0.01	0.02	0.02
14	s2	0.00	0.00	0.00	-0.04	-0.02	-0.02	-0.02	-0.22	-0.01	0.00	0.01
	s3	0.00	0.00	0.00	-0.03	-0.03	-0.03	-0.02	-0.01	0.00	0.01	0.02
	s	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	s1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
15	s2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	s3	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	s	0.00	0.00	0.00	0.00	0.26	0.35	0.47	0.62	0.79	0.96	0.55
	s1	0.00	0.00	0.00	0.00	0.00	0.11	0.18	0.28	0.38	0.51	0.68
16	s2	0.00	0.00	0.00	0.00	-0.36	-0.46	-0.56	-0.74	-0.92	-1.08	0.68
	s3	0.00	0.00	0.00	0.00	0.21	0.46	0.63	0.90	1.16	1.46	0.08
	s	0.00	0.00	0.00	0.00	-0.02	-0.10	-0.15	-0.22	-0.28	-0.37	-0.47
	s1	0.00	0.00	0.00	0.00	0.01	0.03	0.04	0.07	0.09	0.10	0.11
17	s2	0.00	0.00	0.00	0.00	-0.08	-0.10	-0.10	-0.10	-0.07	-0.09	-0.09
	s3	0.00	0.00	0.00	0.00	0.06	0.09	0.11	0.15	0.17	0.20	0.22
	s	0.00	0.00	0.00	0.01	-0.02	-0.02	-0.03	-0.04	-0.03	-0.03	-0.02
	s1	0.00	0.00	0.00	-0.02	0.01	0.03	0.04	0.05	0.07	0.09	0.11
18	s2	0.00	0.00	0.00	-0.03	0.01	0.02	0.03	0.05	0.07	0.09	0.10
	s3	0.00	0.00	0.00	-0.02	0.00	0.01	0.02	0.04	0.05	0.08	0.10

Table 5.4-PSN5 Slides in Beam PSN5-S6M

STATION	APPLIED SHEAR(KN)	75.0	90.0	97.5	105.0	120.0	135.0	150.0	165.0	180.0	195.0	210.0
						SIDE B Slides (mm)						
	s	0.00	0.00	0.00	0.00	0.00	0.10	-0.06	0.23	0.13	0.82	0.53
	s1	0.00	0.00	0.00	0.00	0.00	0.05	0.03	0.24	0.31	0.04	0.60
11	s2	0.00	0.00	0.00	0.00	0.00	-0.06	-0.09	-0.14	-0.13	-1.55	-0.21
	s3	0.00	0.00	0.00	0.00	0.00	0.12	0.07	0.43	0.51	0.81	1.02
	s	0.00	0.00	0.00	0.00	0.00	-0.02	-0.08	-0.10	-0.13	-0.19	-0.20
	s1	0.00	0.00	0.00	0.00	0.00	0.06	0.10	0.16	0.22	0.27	0.36
12	s2	0.00	0.00	0.00	0.00	0.00	-0.08	-0.07	-0.06	-0.05	-0.04	-0.00
	s3	0.00	0.00	0.00	0.00	0.00	0.12	0.19	0.27	0.36	0.43	0.56
	s	0.00	0.00	0.00	0.00	0.18	-0.04	0.18	0.34	0.36	0.78	1.09
	s1	0.00	0.00	0.00	0.00	0.13	0.04	0.03	0.05	-0.15	-0.00	-0.12
13	s2	0.00	0.00	0.00	0.00	0.13	-0.17	-0.61	-0.91	-1.42	-1.80	-2.43
	s3	0.00	0.00	0.00	0.00	0.16	0.15	0.38	0.58	0.57	1.01	1.20
	s	0.00	0.00	0.00	0.00	0.02	0.05	0.06	0.04	0.03	0.02	0.01
	s1	0.00	0.00	0.00	0.00	0.03	0.07	0.07	0.07	0.06	0.06	0.06
14	s2	0.00	0.00	0.00	0.00	-0.06	0.00	-0.02	-0.00	-0.01	-0.01	-0.02
	s3	0.00	0.00	0.00	0.00	0.09	0.10	0.12	0.11	0.10	0.10	0.10
	s	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	s1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
15	s2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	s3	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	s	0.00	0.00	0.00	0.00	0.00	0.10	0.11	-0.00	0.01	-0.10	-0.14
	s1	0.00	0.00	0.00	0.00	0.00	0.05	0.06	0.20	0.35	0.27	0.32
16	s2	0.00	0.00	0.00	0.00	0.00	-0.19	-0.45	-0.18	0.10	-0.19	-0.24
	s3	0.00	0.00	0.00	0.00	0.00	0.18	0.34	0.41	0.48	0.52	0.63
	s	0.00	0.00	0.00	0.00	0.00	0.13	0.23	0.27	0.85	0.52	0.38
	s1	0.00	0.00	0.00	0.00	0.00	0.02	0.15	0.38	0.00	0.67	0.65
17	s2	0.00	0.00	0.00	0.00	0.00	-0.43	-0.46	-0.19	-1.62	-0.22	-0.23
	s3	0.00	0.00	0.00	0.00	0.00	0.26	0.49	0.69	0.92	1.17	1.15
	s	0.00	0.00	0.02	0.03	-0.04	-0.04	-0.04	-0.04	0.16	-0.04	-0.04
	s1	0.00	0.00	-0.00	-0.01	-0.08	-0.01	0.00	0.01	0.17	0.01	0.02
18	s2	0.00	0.00	-0.01	-0.02	-0.11	-0.04	-0.02	-0.02	0.27	-0.02	-0.02
	s3	0.00	0.00	-0.00	-0.01	-0.07	0.01	0.02	0.03	0.02	0.03	0.04

Table 5.4-PSN6 Slides in Beam PSN6-WS

STATION	APPLIED SHEAR(KN)	SIDE A											
		75.0	90.0	97.5	105.0	112.5	120.0	135.0	150.0	165.0	180.0	195.0	210.0
		Slides (mm)											
	s	0.00	0.00	0.00	0.00	0.00	0.04	0.05	0.08	0.11	0.17	0.22	0.28
	s1	0.00	0.00	0.00	0.00	0.00	0.00	0.02	0.05	0.08	0.11	0.13	0.16
11	s2	0.00	0.00	0.00	0.00	0.00	-0.04	-0.08	-0.12	-0.16	-0.23	-0.31	-0.40
	s3	0.00	0.00	0.00	0.00	0.00	0.02	0.06	0.13	0.18	0.26	0.32	0.40
	s	0.00	0.00	0.00	0.00	0.00	0.18	0.15	0.25	0.22	0.08	-0.04	-0.18
	s1	0.00	0.00	0.00	0.00	0.00	0.00	0.11	0.19	0.25	0.18	0.12	0.07
12	s2	0.00	0.00	0.00	0.00	0.00	-0.32	-0.20	-0.27	-0.35	-0.45	-0.59	-0.70
	s3	0.00	0.00	0.00	0.00	0.00	0.12	0.27	0.44	0.53	0.49	0.47	0.44
	s	0.00	0.00	0.00	0.00	0.05	0.02	0.01	-0.04	0.05	0.17	0.13	0.53
	s1	0.00	0.00	0.00	0.00	0.01	0.06	0.08	0.10	0.19	0.35	0.38	0.68
13	s2	0.00	0.00	0.00	0.00	-0.06	-0.07	-0.09	-0.09	-0.11	-0.14	-0.15	-0.17
	s3	0.00	0.00	0.00	0.00	0.06	0.14	0.18	0.22	0.38	0.67	0.73	1.25
	s	0.00	0.00	0.00	0.01	-0.01	-0.01	-0.04	-0.04	-0.05	-0.05	-0.05	-0.05
	s1	0.00	0.00	0.00	-0.00	-0.02	0.02	0.03	0.02	0.02	0.02	0.02	0.03
14	s2	0.00	0.00	0.00	-0.03	-0.05	-0.02	-0.01	-0.03	-0.04	-0.05	-0.06	-0.06
	s3	0.00	0.00	0.00	0.01	-0.01	0.04	0.04	0.05	0.05	0.07	0.09	0.11
	s	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	s1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
15	s2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	s3	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	s	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	s1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
16	s2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	s3	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	s	0.00	0.00	0.00	0.00	0.00	0.09	0.04	0.00	0.00	-0.04	-0.07	-0.12
	s1	0.00	0.00	0.00	0.00	0.00	0.03	0.06	0.07	0.08	0.10	0.12	0.14
17	s2	0.00	0.00	0.00	0.00	0.00	-0.15	-0.15	-0.17	-0.19	-0.22	-0.25	-0.26
	s3	0.00	0.00	0.00	0.00	0.00	0.14	0.19	0.23	0.26	0.31	0.36	0.41
	s	0.00	0.05	0.06	0.20	0.18	0.00	-0.01	-0.02	-0.03	-0.03	-0.02	-0.01
	s1	0.00	-0.00	-0.01	0.00	0.00	-0.06	-0.02	-0.02	-0.02	-0.01	-0.00	0.01
18	s2	0.00	-0.01	-0.02	-0.08	-0.11	-0.12	-0.07	-0.07	-0.07	-0.07	-0.07	-0.07
	s3	0.00	-0.00	0.01	0.15	0.18	0.00	0.03	0.04	0.04	0.05	0.07	0.09

Table 5.4-PSN6 Slides in Beam PSN6-WS

	APPLIED	SIDE B											
STATION	SHEAR(KN)	75.0	90.0	97.5	105.0	112.5	120.0	135.0	150.0	165.0	180.0	195.0	210.0
		Slides (mm)											
	s	0.00	0.00	0.00	0.00	0.00	0.00	0.11	0.20	0.22	0.25	0.29	0.34
	s1	0.00	0.00	0.00	0.00	0.00	0.00	0.08	0.20	0.28	0.36	0.43	0.55
11	s2	0.00	0.00	0.00	0.00	0.00	0.00	-0.08	-0.07	-0.08	-0.10	-0.11	-0.08
	s3	0.00	0.00	0.00	0.00	0.00	0.00	0.19	0.37	0.48	0.60	0.72	0.89
	s	0.00	0.00	0.00	0.00	0.00	0.04	-0.07	-0.10	-0.10	-0.10	-0.08	-0.03
	s1	0.00	0.00	0.00	0.00	0.00	0.05	0.03	0.09	0.13	0.19	0.27	0.40
12	s2	0.00	0.00	0.00	0.00	0.00	-0.08	-0.10	-0.09	-0.10	-0.10	-0.09	-0.03
	s3	0.00	0.00	0.00	0.00	0.00	0.11	0.09	0.17	0.25	0.34	0.46	0.63
	s	0.00	0.00	0.00	0.00	0.00	0.02	0.14	0.18	0.14	0.11	0.10	0.10
	s1	0.00	0.00	0.00	0.00	0.00	0.05	0.23	0.31	0.27	0.22	0.19	0.16
13	s2	0.00	0.00	0.00	0.00	0.00	-0.07	-0.07	0.03	-0.00	-0.07	-0.11	-0.20
	s3	0.00	0.00	0.00	0.00	0.00	0.11	0.42	0.50	0.44	0.40	0.39	0.38
	s	0.00	0.00	0.00	0.00	0.00	0.04	0.03	0.03	0.01	0.02	0.00	0.00
	s1	0.00	0.00	0.00	0.00	-0.01	-0.01	-0.02	-0.04	-0.05	-0.06	-0.07	-0.08
14	s2	0.00	0.00	0.00	0.00	-0.04	-0.06	-0.07	-0.08	-0.09	-0.10	-0.11	-0.12
	s3	0.00	0.00	0.00	0.00	0.00	0.04	0.02	0.00	-0.01	-0.01	-0.03	-0.03
	s	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	s1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
15	s2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	s3	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	s	0.00	0.00	0.00	0.00	0.00	-0.10	-0.06	0.06	0.11	-0.03	-0.02	-0.07
	s1	0.00	0.00	0.00	0.00	0.00	-0.13	0.05	0.20	0.31	0.19	0.32	0.37
16	s2	0.00	0.00	0.00	0.00	0.00	0.01	0.06	0.06	0.05	0.02	0.07	0.11
	s3	0.00	0.00	0.00	0.00	0.00	-0.14	0.04	0.26	0.45	0.28	0.45	0.51
	s	0.00	0.00	0.00	0.00	0.11	0.04	-0.02	0.00	0.17	0.37	0.53	0.72
	s1	0.00	0.00	0.00	0.00	0.00	0.04	0.07	0.14	0.30	0.46	0.62	0.81
17	s2	0.00	0.00	0.00	0.00	-0.07	-0.08	-0.08	-0.06	-0.06	-0.04	-0.00	0.05
	s3	0.00	0.00	0.00	0.00	0.09	0.15	0.18	0.30	0.58	0.87	1.13	1.43
	s	0.00	0.00	0.02	0.01	-0.02	0.19	0.44	0.45	0.62	0.44	0.41	0.55
	s1	0.00	0.00	-0.00	-0.00	-0.04	-0.03	-0.02	0.15	-0.02	0.15	0.15	-0.03
18	s2	0.00	0.00	0.00	-0.00	-0.03	-0.16	-0.30	-0.11	-0.40	-0.11	-0.10	-0.37
	s3	0.00	0.00	-0.00	-0.00	-0.04	0.17	0.43	0.57	0.60	0.57	0.54	0.54

Table 5.5 Calculated Values of Moment-curvature Relationship

Ecc (*E-6)	M (KN*M)		Phai (*E-6/mm)	V (KN)	Sts4 (MPa)	Stp2 (MPa)	X (mm)	Dens (*E-6)	Denp (*E-6)
32	0.00		-0.61	0.0	-50	1111	53	0	0
-64	43.66		0.00	38.0	-13	1139	----	177	147
-104	62.63	Mo	0.21	54.5	-1	1148	486	246	192
-155	85.32	Mcr	0.51	74.2	17	1161	303	321	260
-200	97.76		0.89	85.0	44	1181	223	452	368
-300	130.00		1.86	113.0	115	1235	161	796	654
-400	164.07		2.85	142.7	187	1291	141	1150	949
-500	196.59		3.77	170.9	254	1342	133	1473	1217
-600	229.79		4.74	199.8	325	1397	127	1819	1504
-650	245.56		5.19	213.5	358	1422	125	1979	1637
-700	260.96		5.64	226.9	390	1447	124	2136	1767
-750	274.79	My	6.13	238.9	400	1474	122	2308	1910
-800	286.66		6.76	249.3	400	1513	118	2552	2116
-850	296.83		7.38	258.1	400	1550	115	2785	2312
-900	302.60		8.21	263.1	400	1604	110	3117	2594
-1000	308.71		10.34	268.4	400	1640	97	3995	3344
-1100	311.23		12.65	270.6	400	1656	87	4961	4171
-1500	318.09		23.08	276.6	400	1712	65	9359	7944
-2000	323.68		36.55	281.5	400	1758	55	15053	12830
-2500	326.56		51.49	284.0	400	1792	49	21424	18305
-3000	328.07		65.22	285.3	400	1813	46	27240	23297
-3500	329.16		78.84	286.2	400	1829	44	33007	28246
-4000	330.02		92.50	287.0	400	1841	43	38790	33210
-4500	330.71		106.19	287.6	400	1851	42	44588	38186

Table 5.6 Predicted Shear Strengths for Beam PSN3-D2 Using 20 Different Methods

No.	Vc(KN)	Vu(KN)	Vcr/Vc	Vcmx/Vc	Vmx/Vu	Ref.
1	65.91	114.43	1.59	2.84	2.26	JCI Basic
2	44.09	92.61	2.38	4.25	2.79	JCI 1/SF
3	81.13	129.65	1.29	2.31	1.99	JCI Exact
4	57.96	106.48	1.81	3.24	2.42	Niwa for a/d=<3
5	30.54	79.06	3.44	6.14	3.26	CAN RC
6	62.48	111.00	1.68	3.00	2.33	CAN PC
7	50.89	99.42	2.06	3.68	2.60	CAN RC /RFc
8	104.13	152.66	1.01	1.80	1.69	CAN PC /RFc
9	44.01	92.53	2.39	4.26	2.79	ACI RC
10	87.34	135.87	1.20	2.15	1.90	ACI PC Vc
11	92.11	140.63	1.14	2.04	1.84	ACI PC Vci
12	104.37	152.89	1.01	1.80	1.69	ACI PC Vcw
13	65.59	114.12	1.60	2.86	2.26	Zsutty
14	58.95	107.48	1.78	3.18	2.40	Placas
15	42.24	90.77	2.49	4.44	2.84	Rajagopalan
16	48.58	97.10	2.16	3.86	2.66	ASCE-ACI
17		150.64			1.71	Placas 2
18	(44.01)	141.06	(2.39)	4.26	1.83	Mattock
19	78.41	122.01	1.34	2.39	2.12	CEB/FIP '78
20		125.50			2.05	CAN GENERAL

Table 5.7 Predicted Shear Strengths for Beam PSN4-WDH Using 20 Different Methods

No.	Vc (KN)	Vu (KN)	Vcr/Vc	Vcmx/Vc	Vmx/Vu	Ref.
1	65.91	104.20	1.59	2.84	2.37	JCI Basic
2	44.09	82.38	2.38	4.25	3.00	JCI 1/SF
3	81.13	119.42	1.29	2.31	2.07	JCI Exact
4	57.96	96.25	1.81	3.24	2.57	Niwa for a/d=<3
5	30.54	68.83	3.44	6.14	3.59	CAN RC
6	62.48	100.77	1.68	3.00	2.45	CAN PC
7	50.89	89.19	2.06	3.68	2.77	CAN RC /RFc
8	104.13	142.43	1.01	1.80	1.73	CAN PC /RFc
9	44.01	82.30	2.39	4.26	3.00	ACI RC
10	87.34	125.64	1.20	2.15	1.97	ACI PC Vc
11	92.11	130.40	1.14	2.04	1.89	ACI PC Vci
12	104.37	142.66	1.01	1.80	1.73	ACI PC Vcw
13	65.59	103.89	1.60	2.86	2.38	Zsutty
14	58.95	97.25	1.78	3.18	2.54	Placas
15	42.24	80.54	2.49	4.44	3.07	Rajagopalan
16	48.58	86.87	2.16	3.86	2.84	ASCE-ACI
17		125.72			1.97	Placas 2
18	(44.01)	120.60	(2.39)	4.26	2.05	Mattock
19	78.41	120.73	1.34	2.39	2.05	CEB/FIP '78
20		108.90			2.27	CAN GENERAL

Table 5.8 Predicted Shear Strength for Beam PSN3-D2 by the General Method of Canadian Code

en1 (*E-6)	V (KN)	Theta (Deg)	fv (MPa)	env (*E-6)	Mf (KN*M)	f2mx (MPa)	en2 (*E-6)	enx (*E-6)	Ecc (*E-6)	Np (KN)
1000	51.6	24.8	165	806	59.4	-35.4	-98	95	-178	-107
2000	84.5	28.2	312	1516	97.2	-30.1	-177	308	-317	-60
3000	97.9	27.0	344	2330	112.5	-26.2	-246	423	-383	-27
4000	104.0	25.6	344	3193	119.6	-23.2	-312	494	-420	-3
5000	108.8	24.6	344	4066	125.2	-20.8	-382	552	-450	18
6000	112.7	23.9	344	4943	129.7	-18.8	-457	601	-475	35
7000	115.9	23.3	344	5822	133.3	-17.2	-535	643	-496	51
8000	118.4	22.9	344	6701	136.1	-15.9	-616	683	-515	63
9000	120.4	22.5	344	7579	138.5	-14.7	-702	719	-532	71
10000	121.8	22.3	344	8450	140.1	-13.7	-789	761	-547	78
11000	123.0	22.1	344	9321	141.4	-12.8	-882	798	-561	83
12000	123.9	21.9	344	10190	142.5	-12.1	-982	828	-572	88
13000	124.7	21.8	344	11055	143.4	-11.4	-1091	854	-581	92
14000	125.2	21.7	344	11917	144.0	-10.8	-1212	871	-588	95
15000	125.5	21.7	344	12770	144.4	-10.2	-1347	883	-592	97

Table 5.9 Predicted Shear Strength for Beam PSN4-WDH by the General Method of Canadian Code

en1 (*E-6)	V (KN)	Theta (Deg)	fv (MPa)	env (*E-6)	Mf (KN*M)	f2mx (MPa)	en2 (*E-6)	enx (*E-6)	Ecc (*E-6)	Np (KN)
1000	35.7	18.6	182	889	41.1	-35.4	-85	26	-122	-113
2000	56.7	22.2	348	1695	65.2	-30.1	-140	165	-213	-80
3000	76.9	23.8	510	2479	88.4	-26.2	-210	311	-303	-44
4000	89.4	23.8	593	3305	102.8	-23.2	-281	414	-363	-15
5000	93.4	22.9	593	4194	107.4	-20.8	-343	463	-388	2
6000	96.6	22.2	593	5087	111.0	-18.8	-408	505	-409	17
7000	99.2	21.6	593	5983	114.1	-17.2	-477	541	-426	30
8000	101.4	21.2	593	6880	116.6	-15.9	-549	571	-441	42
9000	103.3	20.9	593	7779	118.8	-14.7	-625	597	-454	51
10000	104.8	20.6	593	8677	120.5	-13.7	-705	619	-465	60
11000	106.1	20.4	593	9573	122.0	-12.8	-789	639	-474	68
12000	107.2	20.2	593	10469	123.3	-12.1	-879	652	-482	72
13000	108.0	20.0	593	11361	124.2	-11.4	-974	665	-488	77
14000	108.6	19.9	593	12249	124.9	-10.8	-1075	677	-493	80
15000	108.9	19.9	593	13131	125.3	-10.2	-1182	687	-497	84

Table 5.10 Beam Strengths (ACI Predictions and Test Results)

Beam	Vc Experimental (KN)	Vc by ACI Code (KN)	Vc(exp.) /Vc(Code)	Vu Experimental (KN)	Vu by ACI Code (KN)	Vu(exp.) /Vu(Code)	Shear Reinforcement Ratio Pv=Avfvy/(fc'bws)
PSN1-0	104	104.4	1.00	187.5	104.4	1.80	-
PSN2-WD	97.5	104.4	0.93	217.7	142.3	1.53	0.0291
PSN3-D2	105	104.4	1.01	258.1	152.9	1.69	0.0372
PSN4-WDH	105	104.4	1.01	247.1	142.7	1.73	0.0294
PSN5-S6M	105	104.4	1.01	253.9	139.1	1.83	0.0266
PSN6-WS	105	104.4	1.01	253.8	144.6	1.76	0.0308

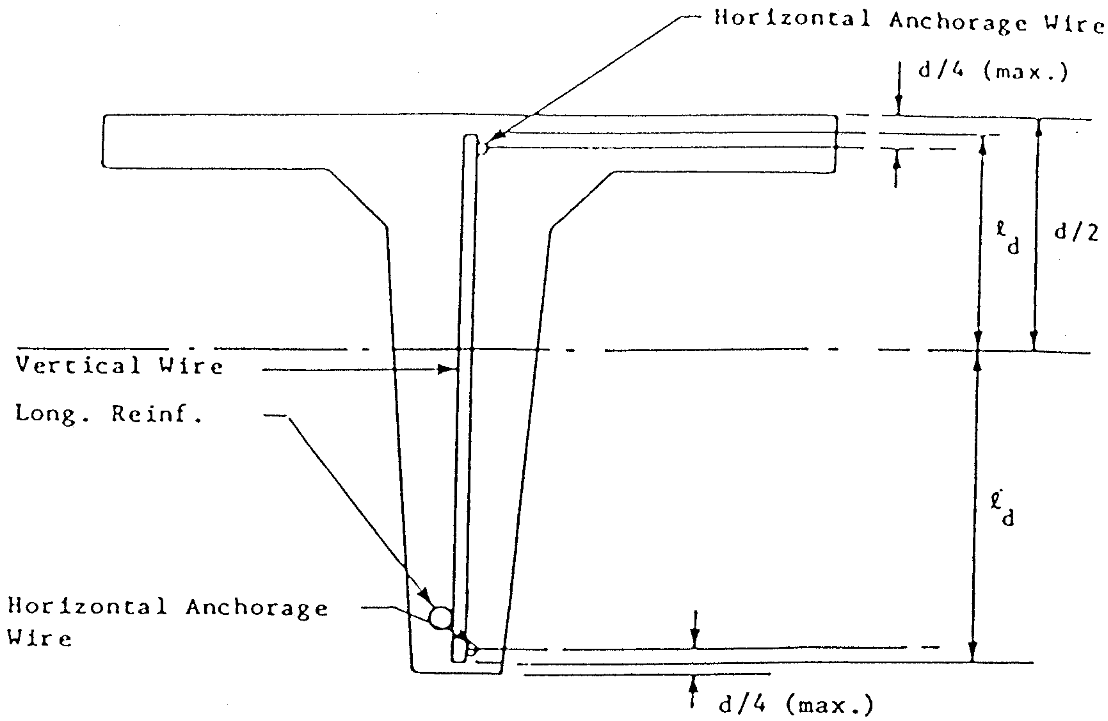


Figure 2.1 PCI/WRI Anchorage Requirement for Deformed WWF

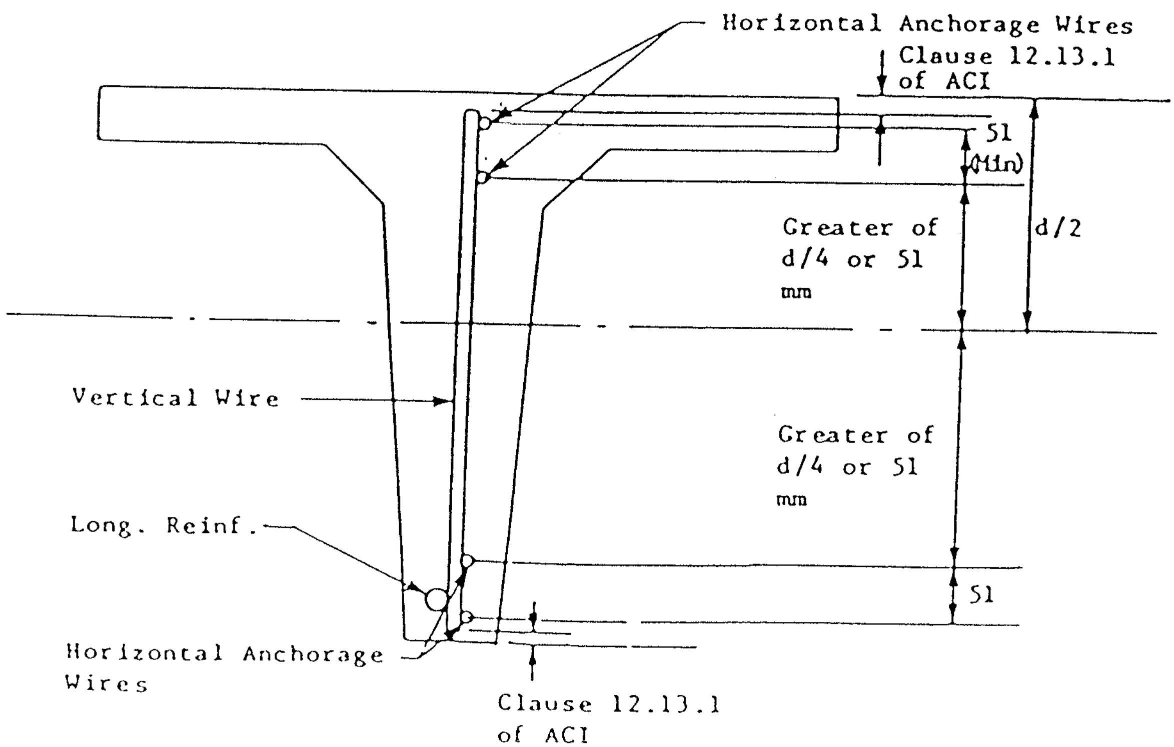


Figure 2.2 PCI/WRI Anchorage Requirement for Smooth WWF and ACI for Deformed and Smooth WWF

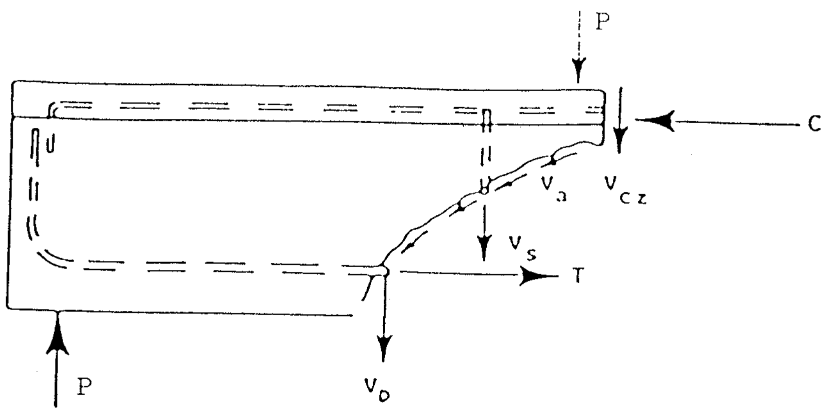


Figure 2.3 Basic Mechanism of Shear Transfer

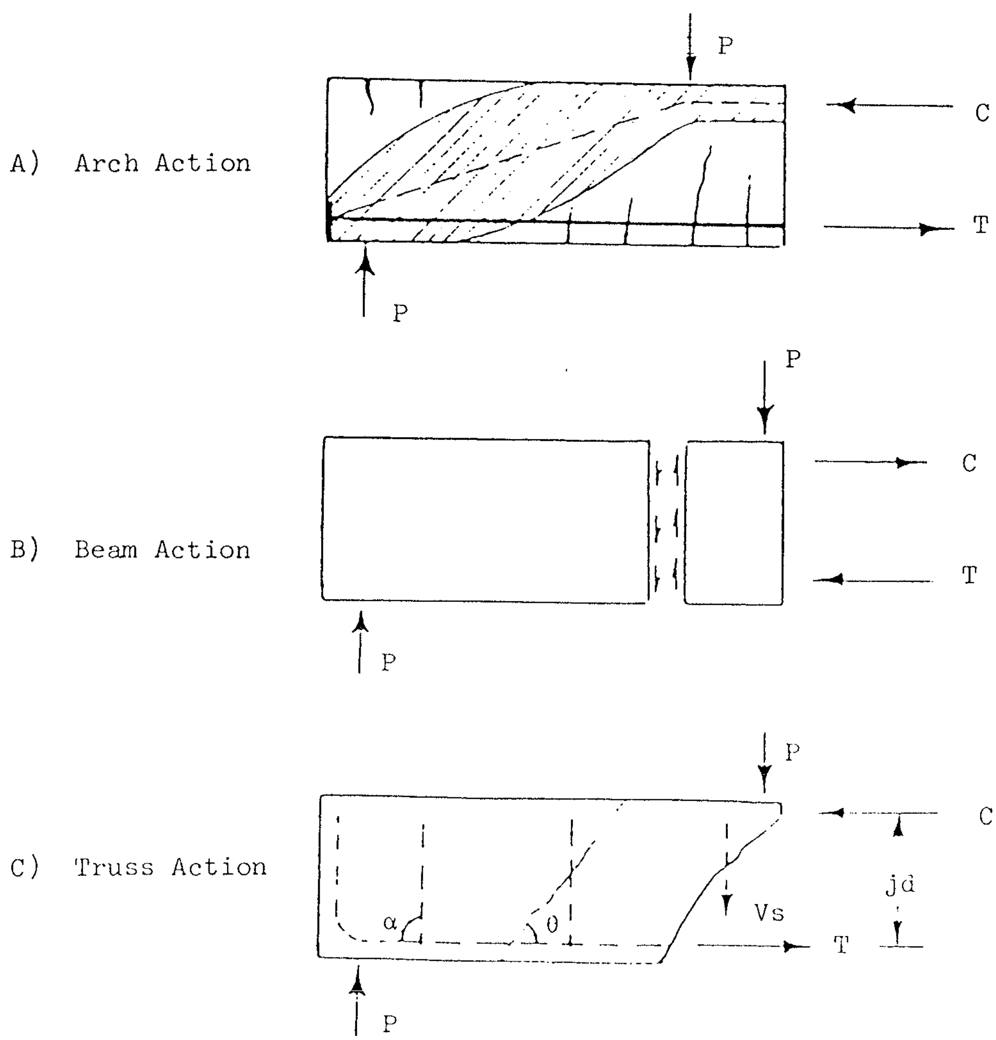


Figure 2.4 The Principal Mechanisms of Shear Resistance

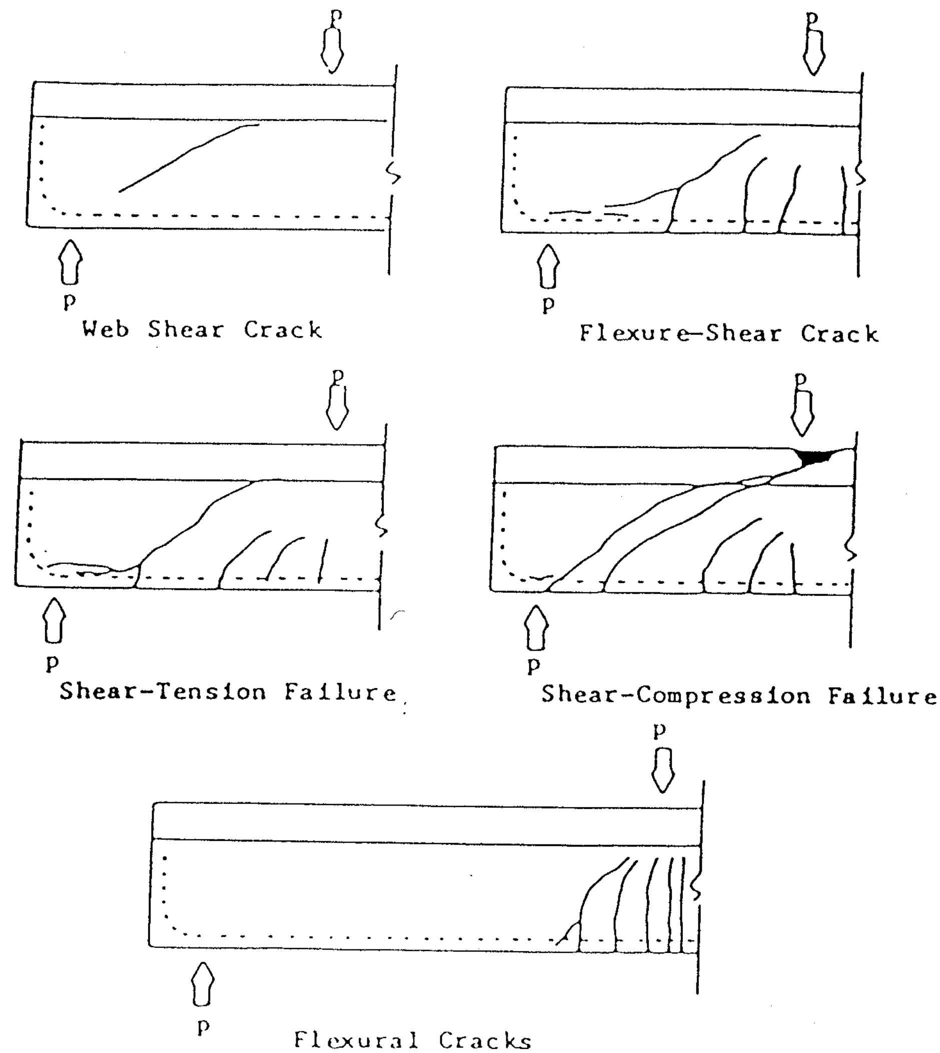


Figure 2.5 Different Types of Cracks

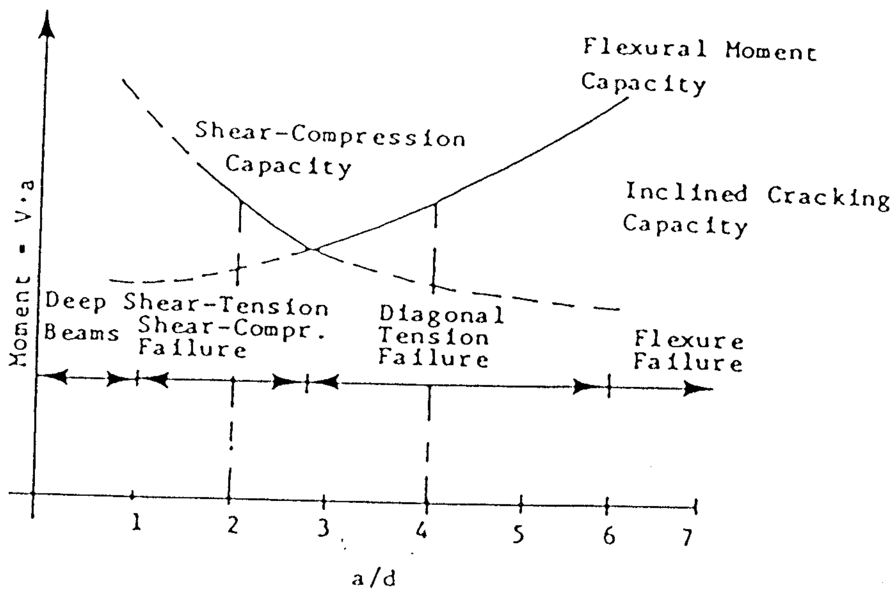


Figure 2.6 Effect of a/d on Cracking of Rectangular Simply-supported Beams

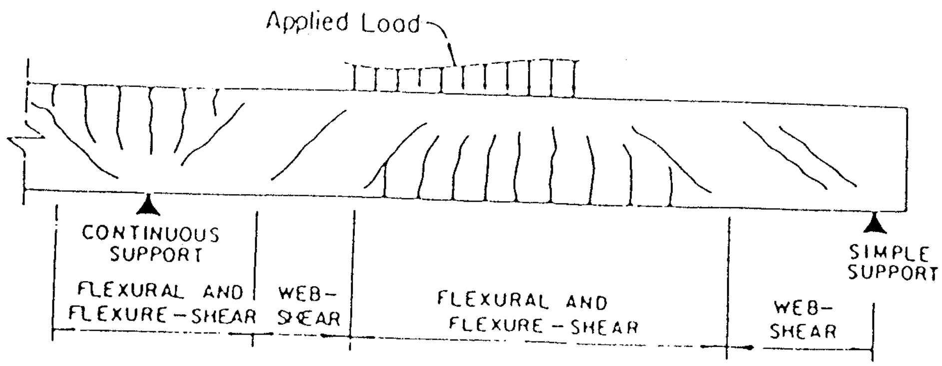


Figure 2.7 Types of cracking in concrete beams

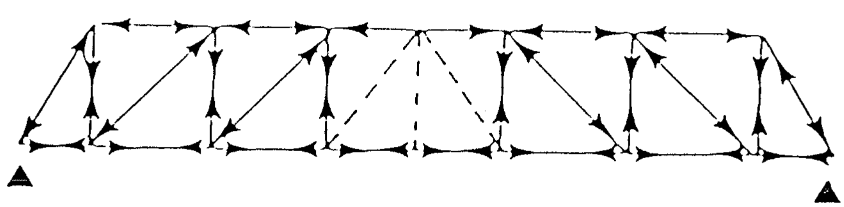


Figure 2. 8 Truss Model

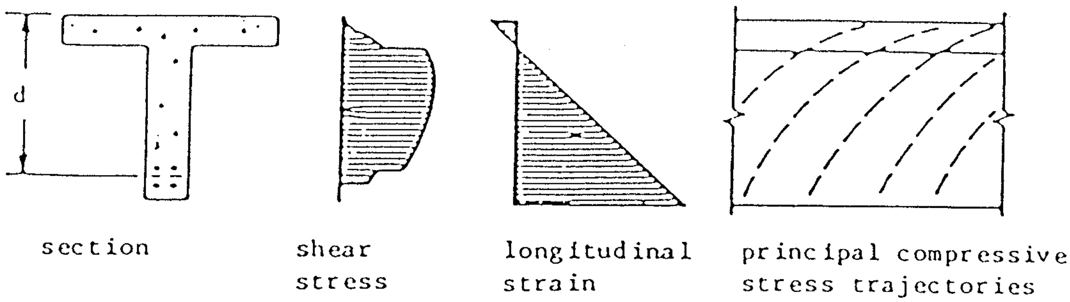


Figure 2.9 Theoretical Stress and Strain Distributions

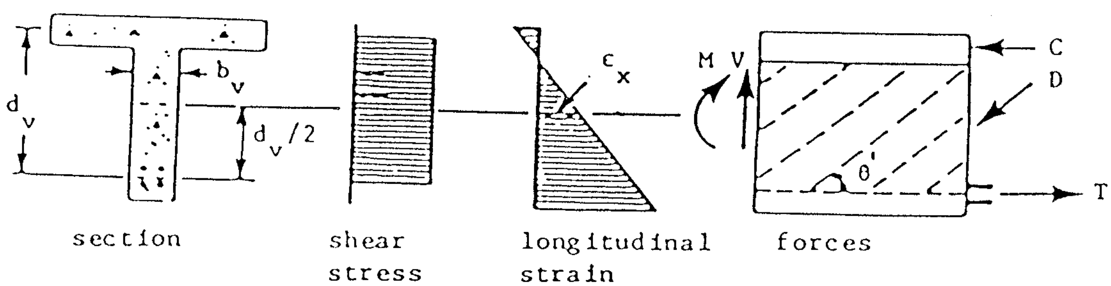


Figure 2.10 Assumed Stress and Strain Distributions

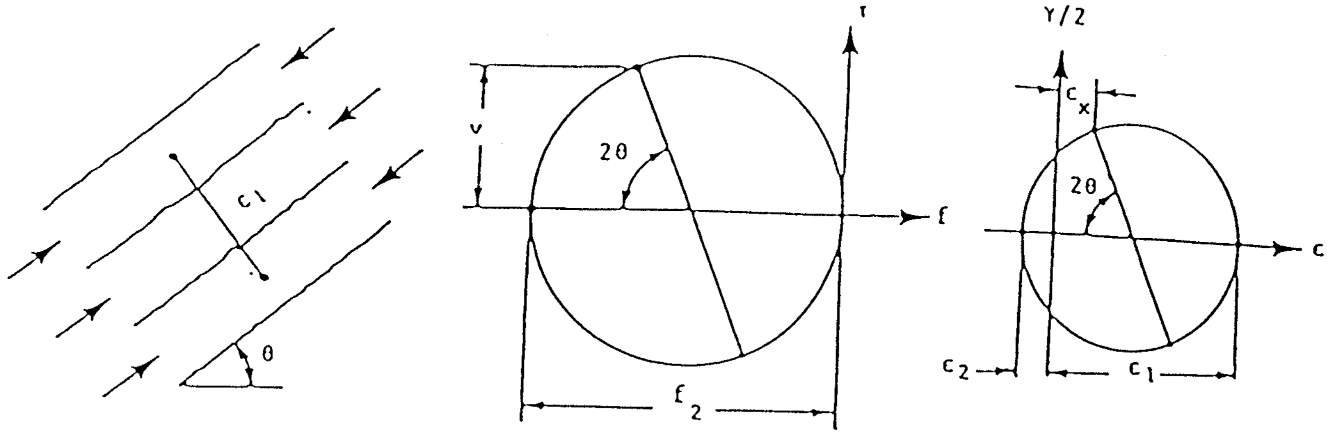


Figure 2.11 Stress and Strain Conditions in Cracked Web

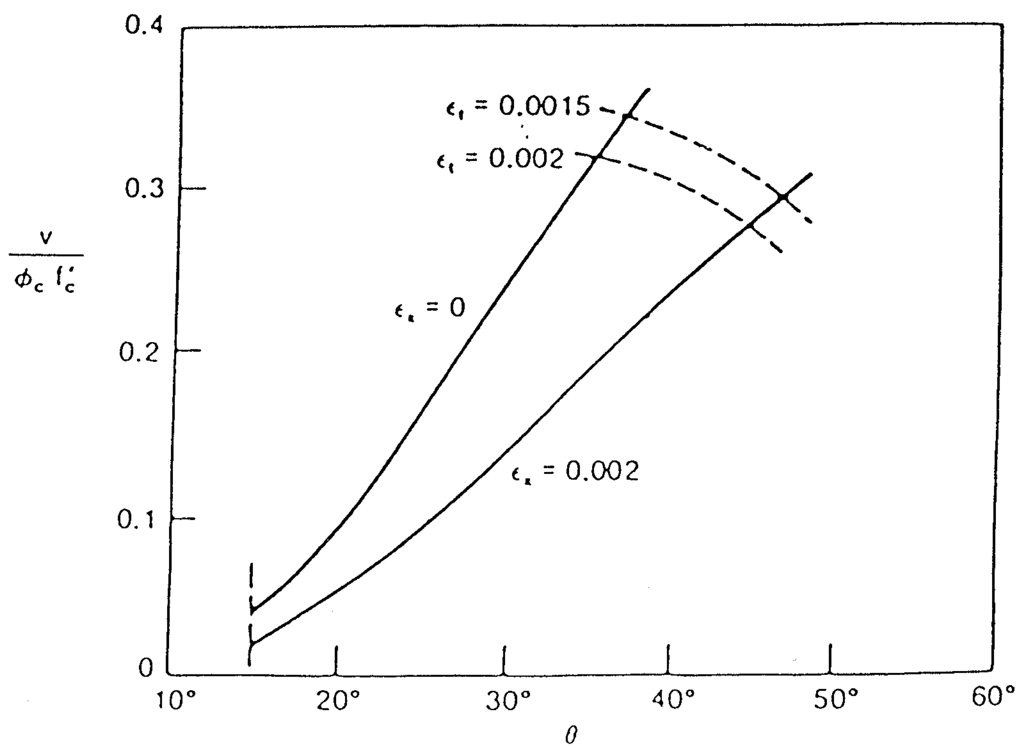


Figure 2.12 Values of θ at which $f_2 = f_{2max}$

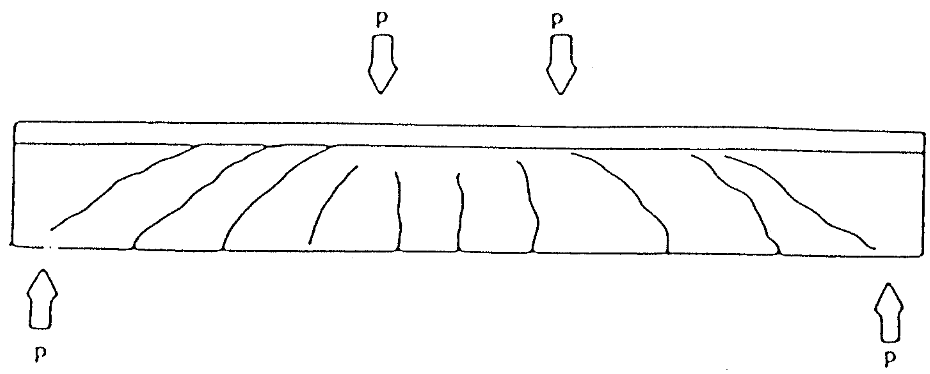


Figure 2.13 Typical Crack Pattern

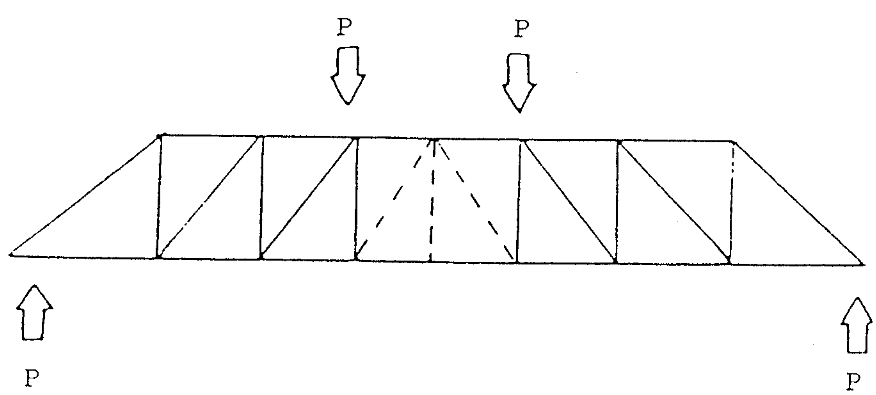


Figure 2.14 Variable Angle Space Truss

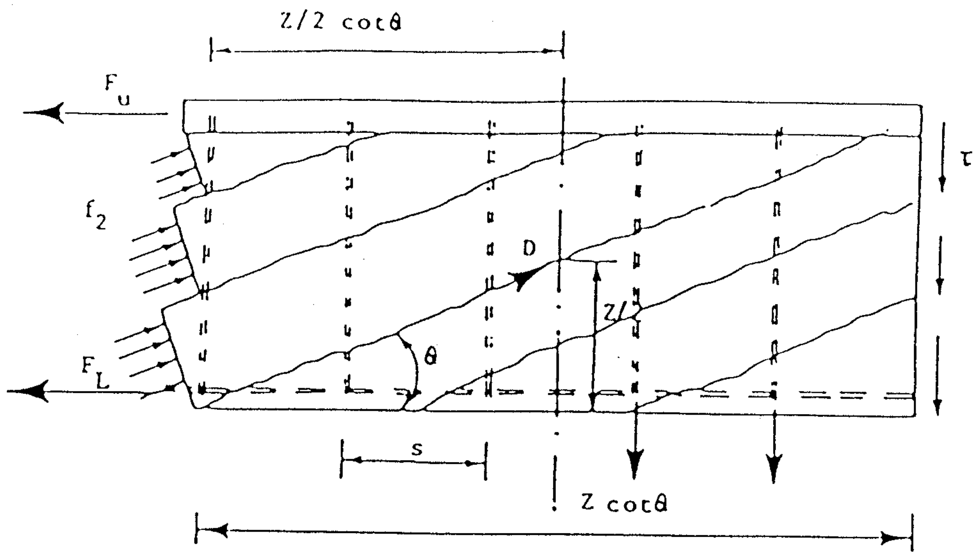


Figure 2.15 Force System in Cracked Web

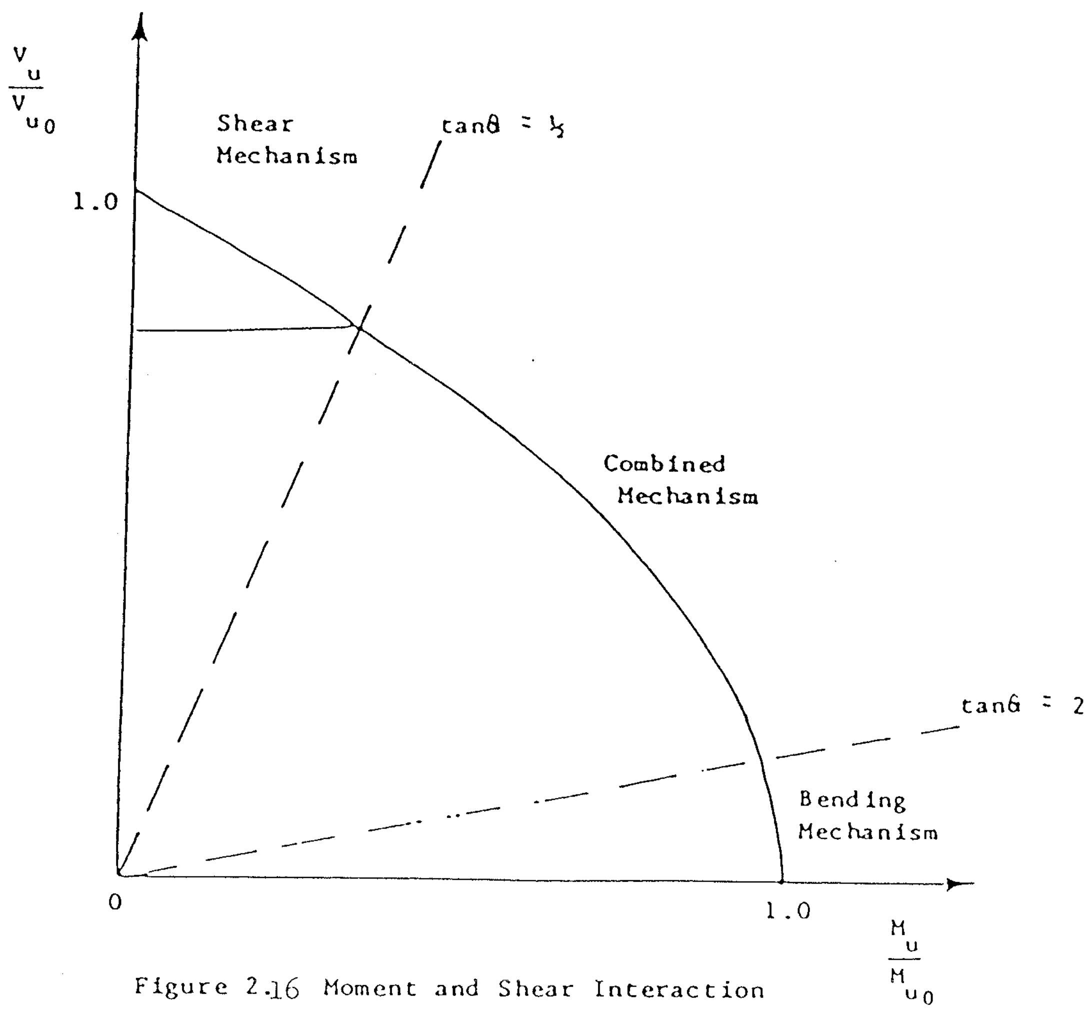


Figure 2.16 Moment and Shear Interaction Diagram

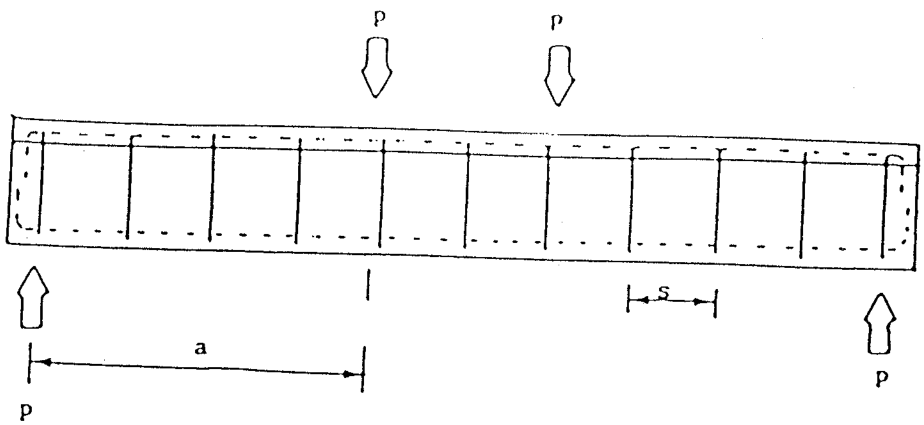


Figure 2.17 Beam with Two-Point Loading

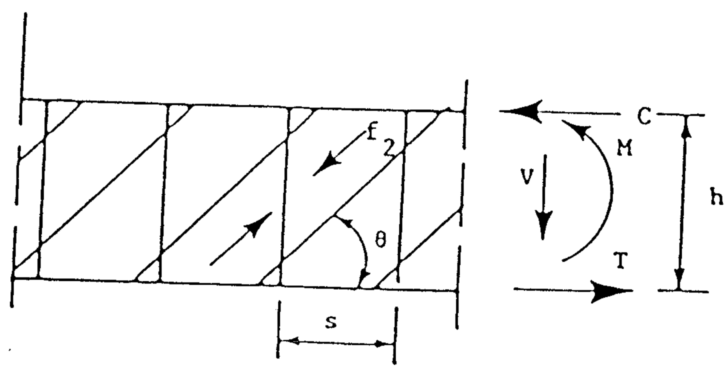


Figure 2.18 Diagonal Compression Stress Field in Web

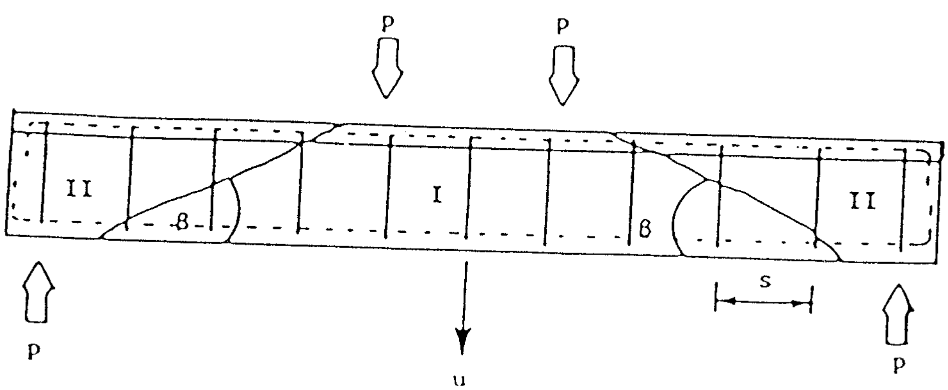


Figure 2.19 Failure Mechanism

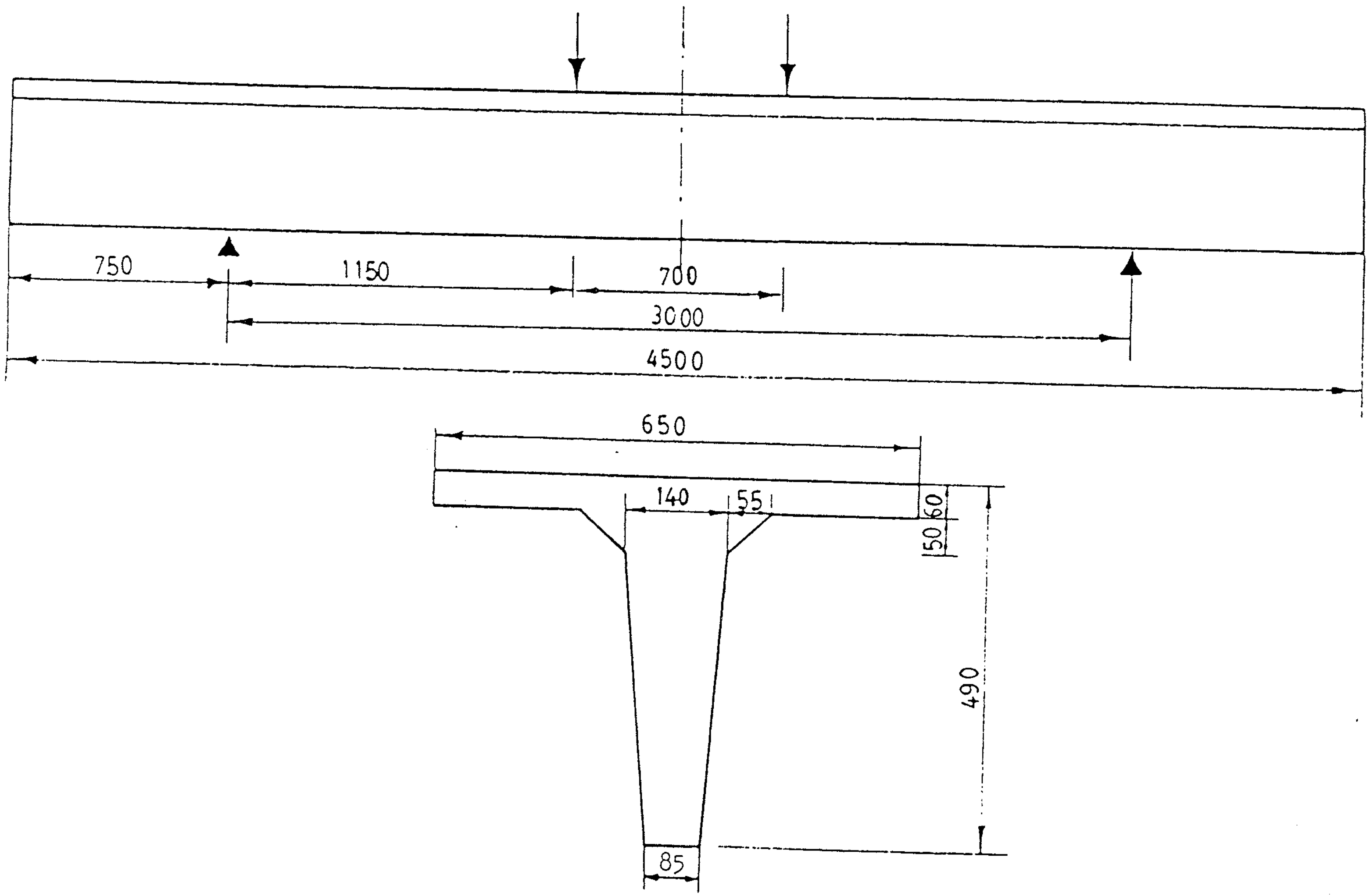


Figure 3.1 Dimensions of the Specimens

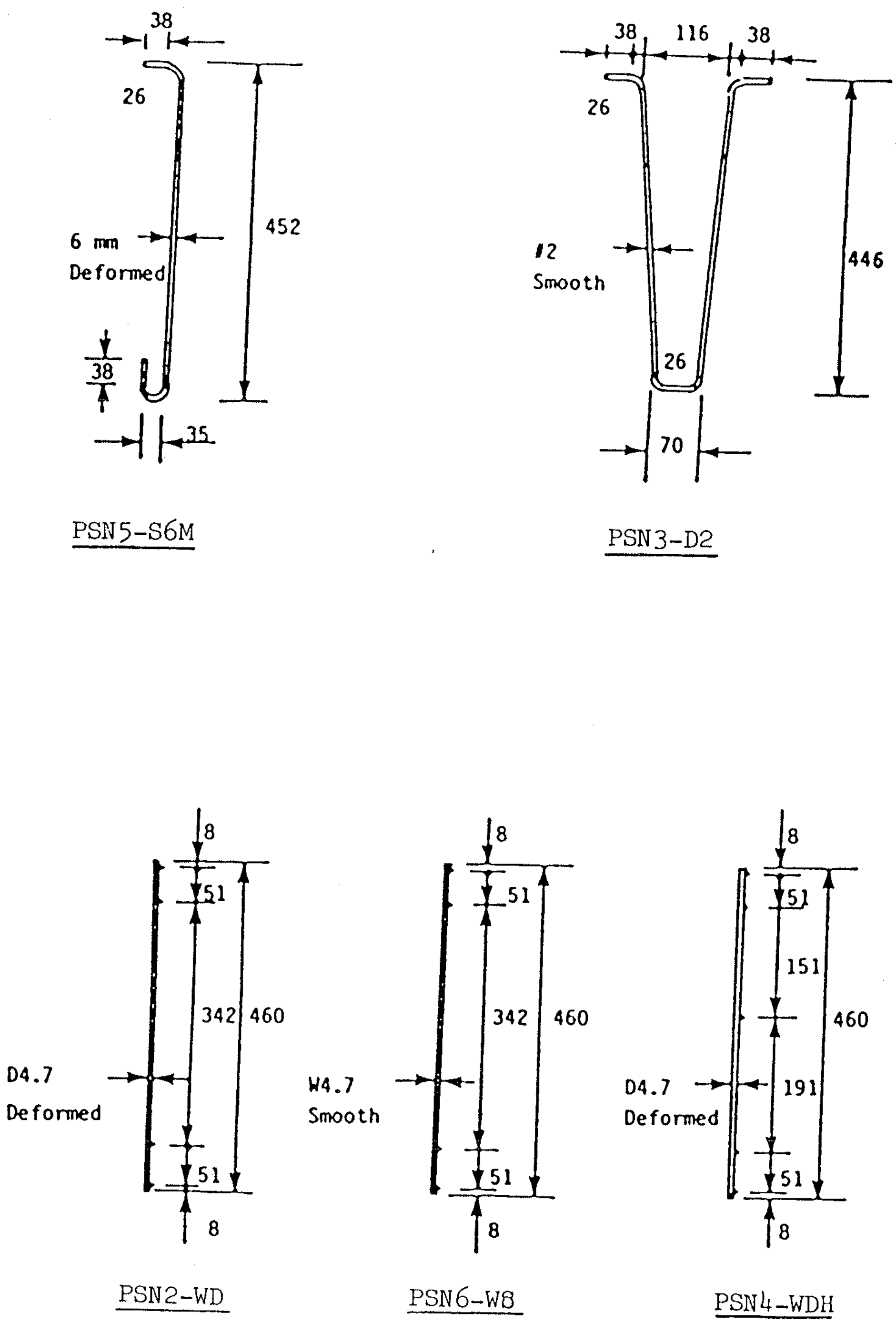


Figure 3.2 Stirrup Configurations

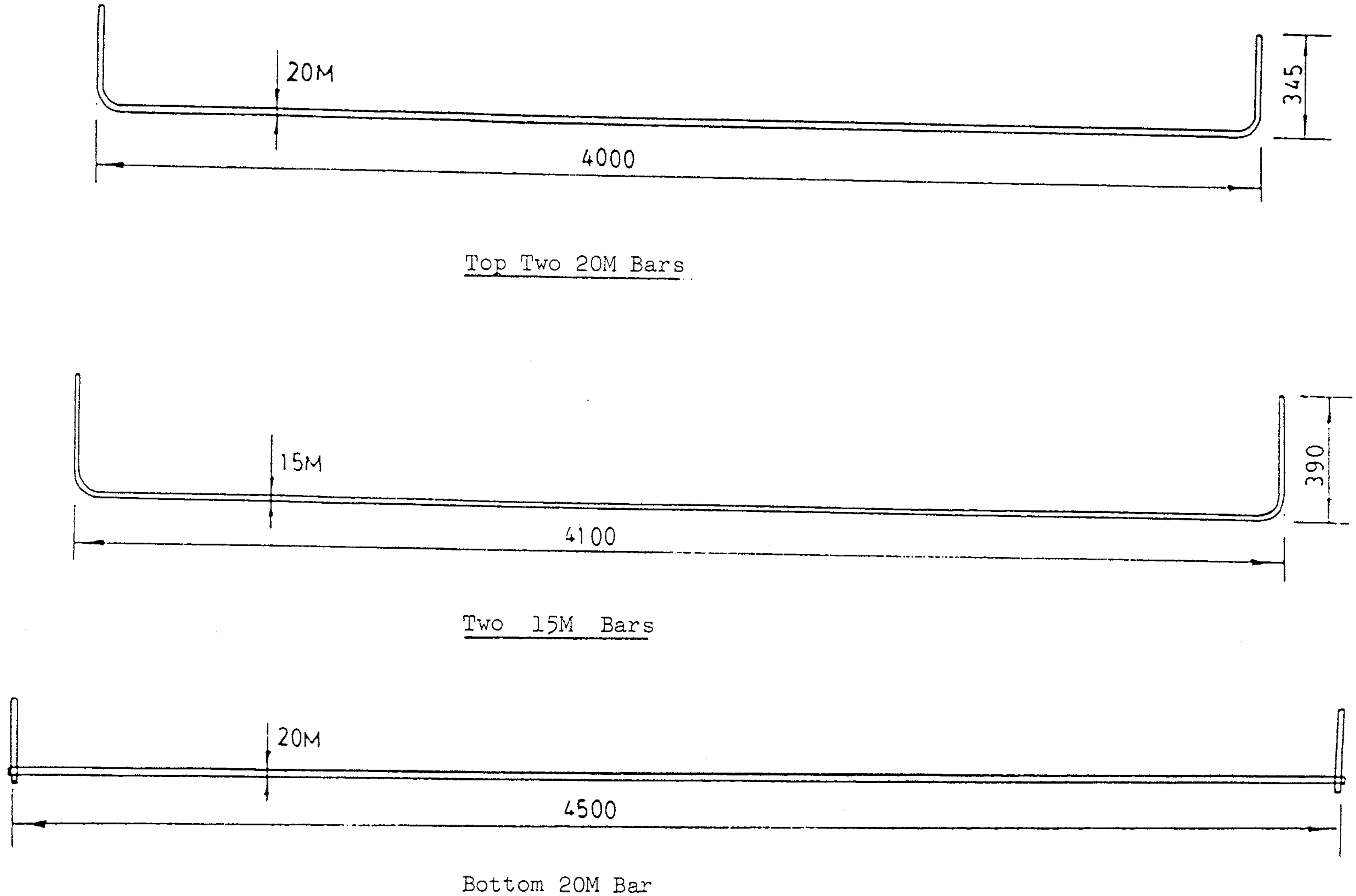
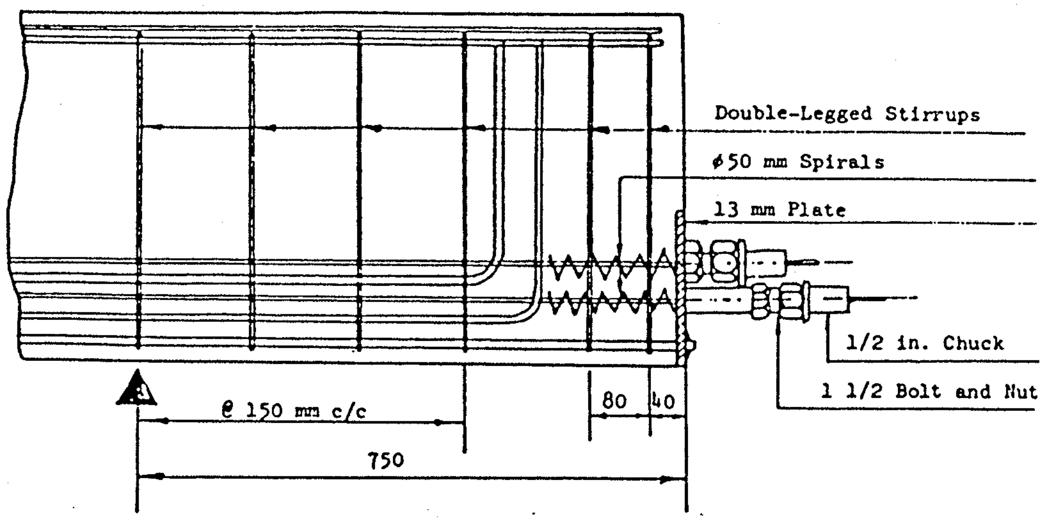


Figure 3.3 Typical Longitudinal Reinforcements



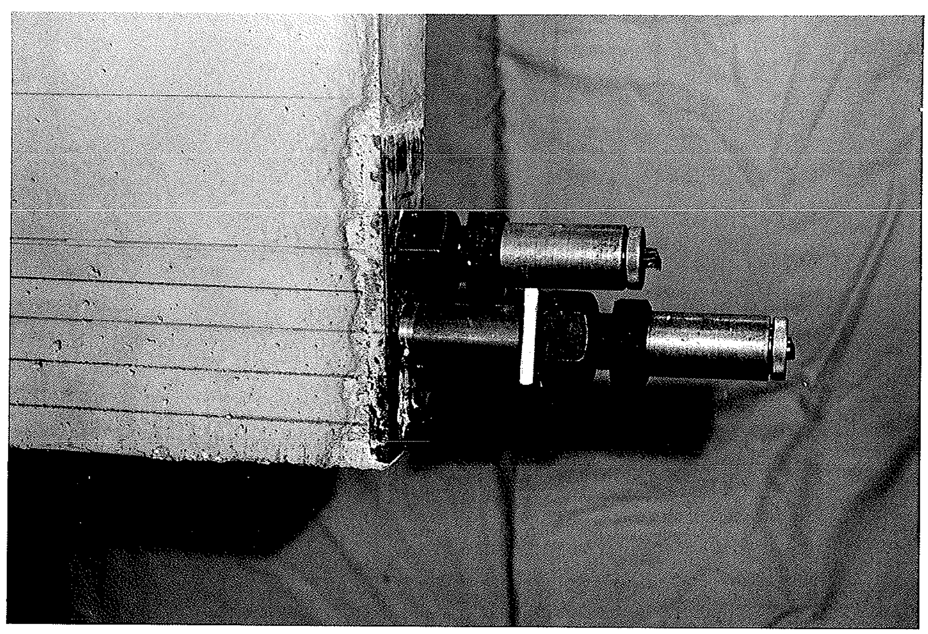


Figure 3.4 End Zone and End Anchorage Device

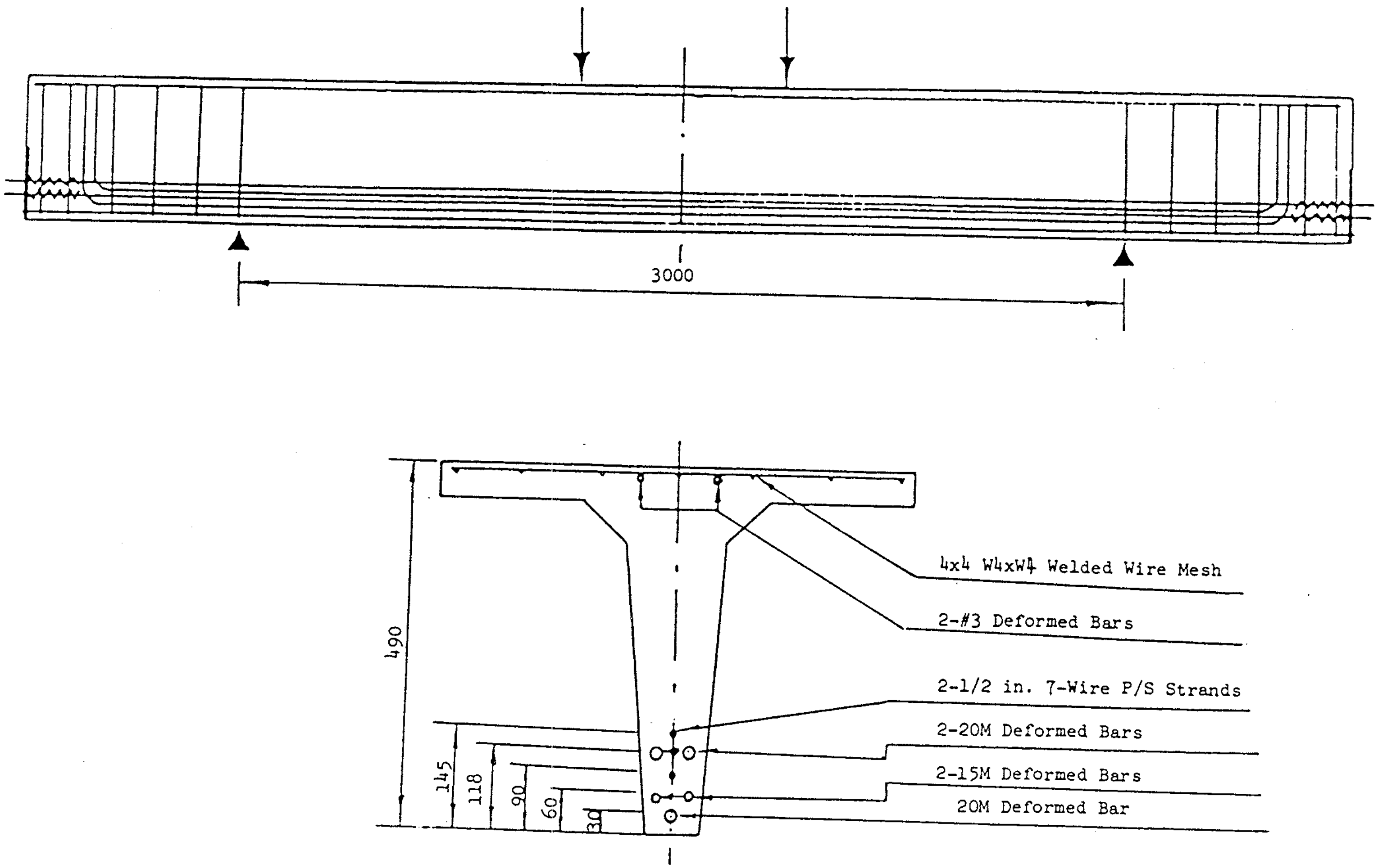


Figure 3.5 Beam PSN1-0 without Shear Reinforcement

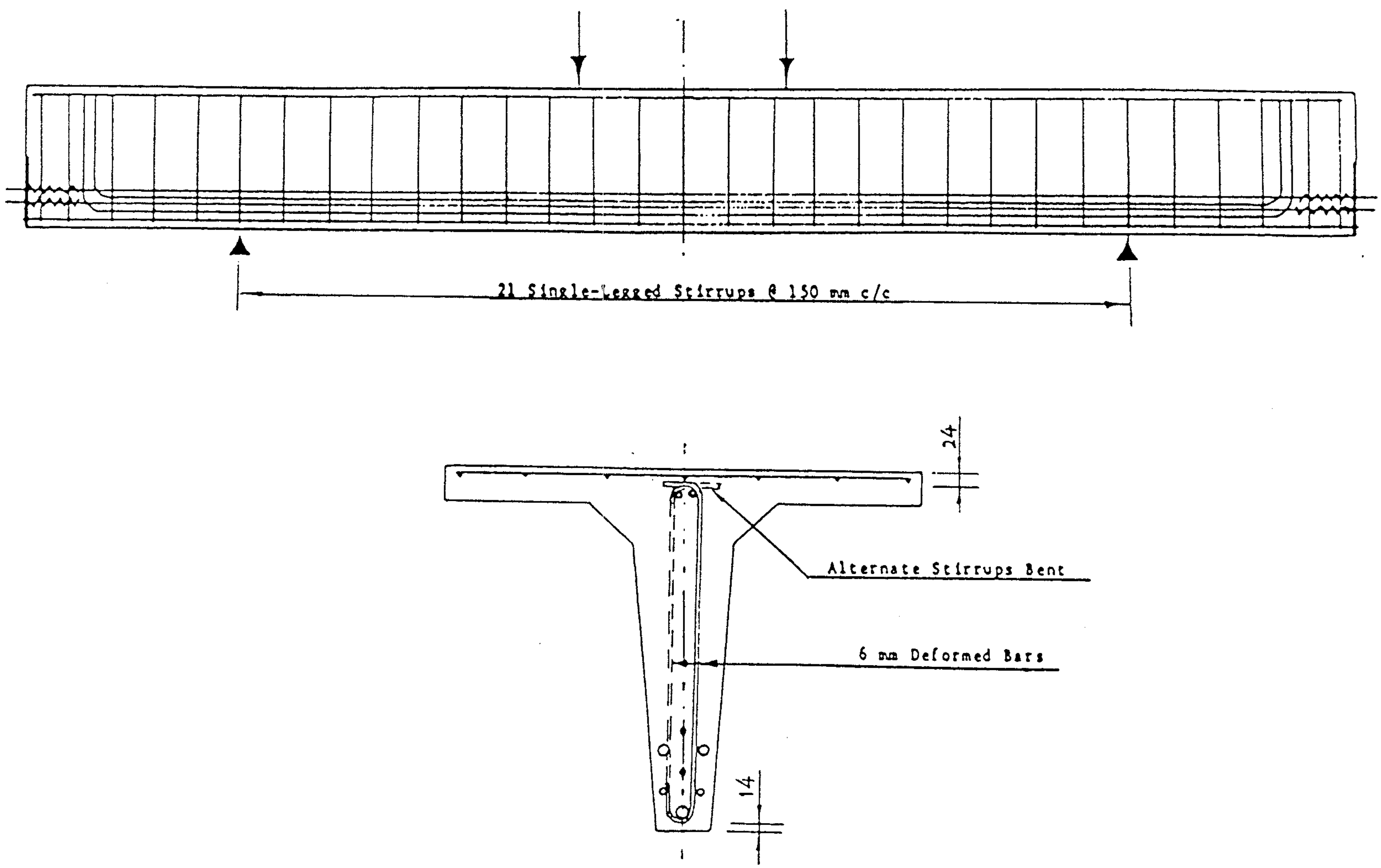


Figure 3.6 Beam PSN5-S6M with Single-Legged Stirrups

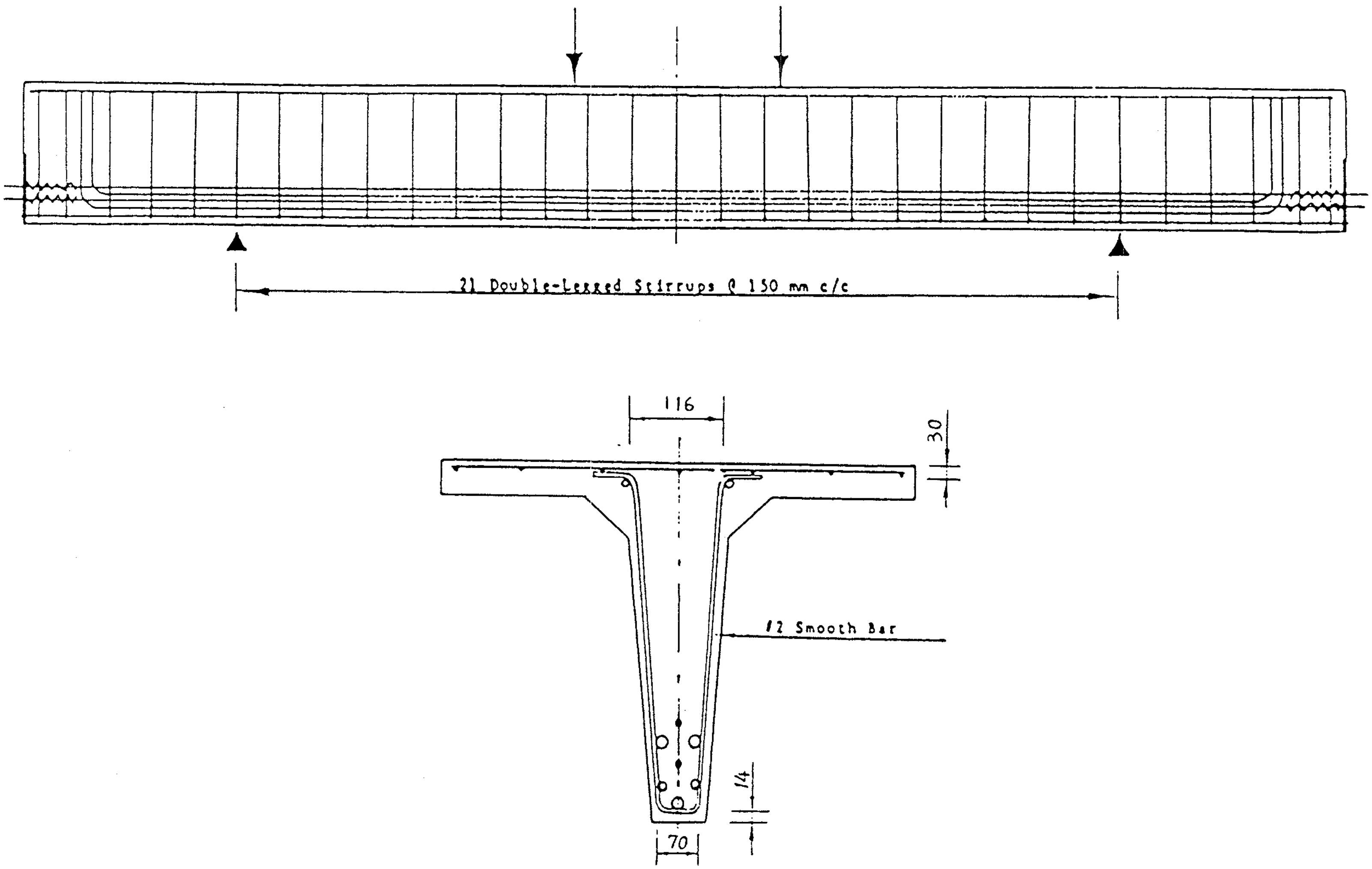


Figure 3.7 Beam PSN3-D2 with Double-Legged Stirrups

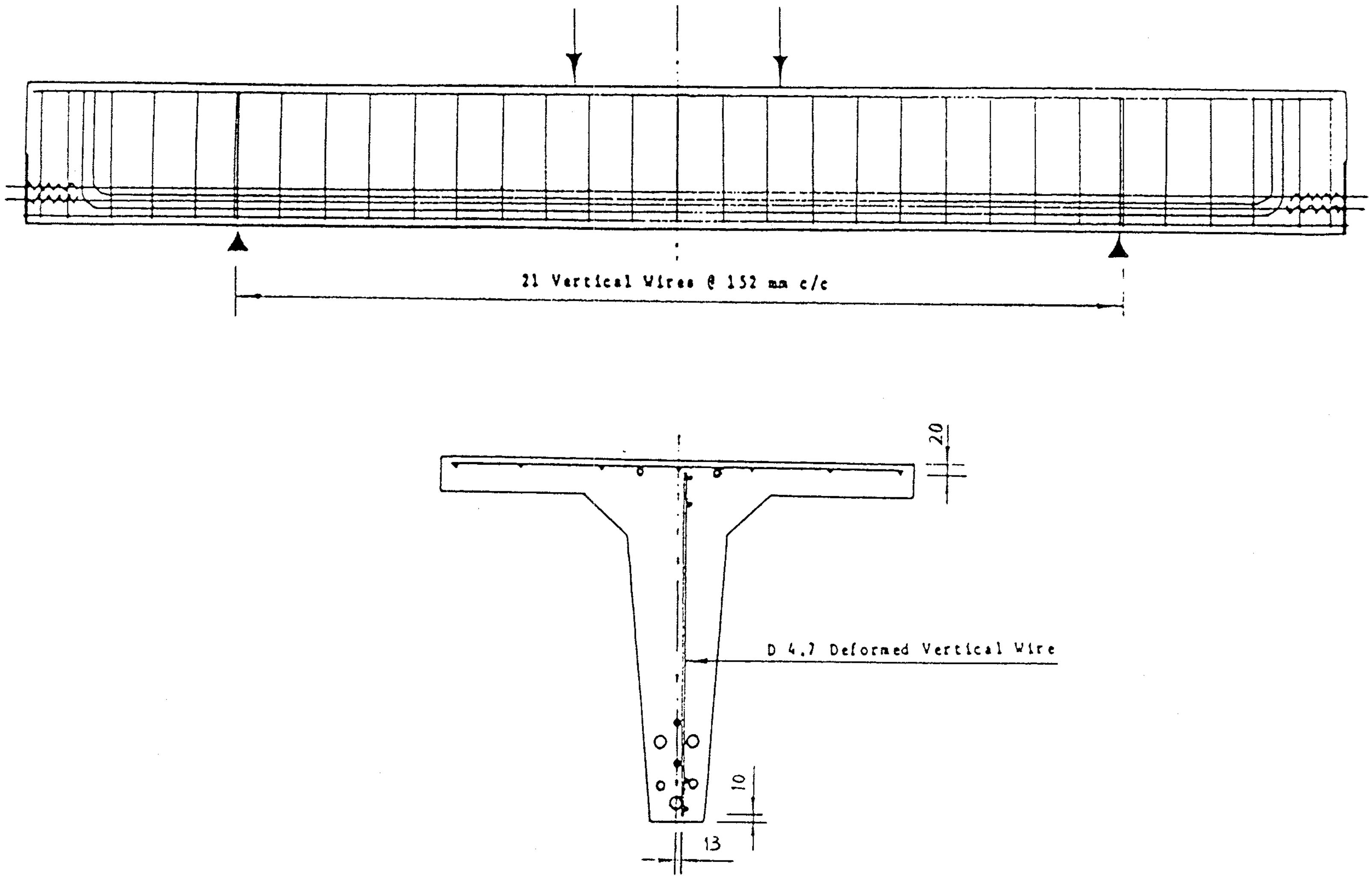


Figure 3.8 Beam PSN2-WD with Deformed WWF

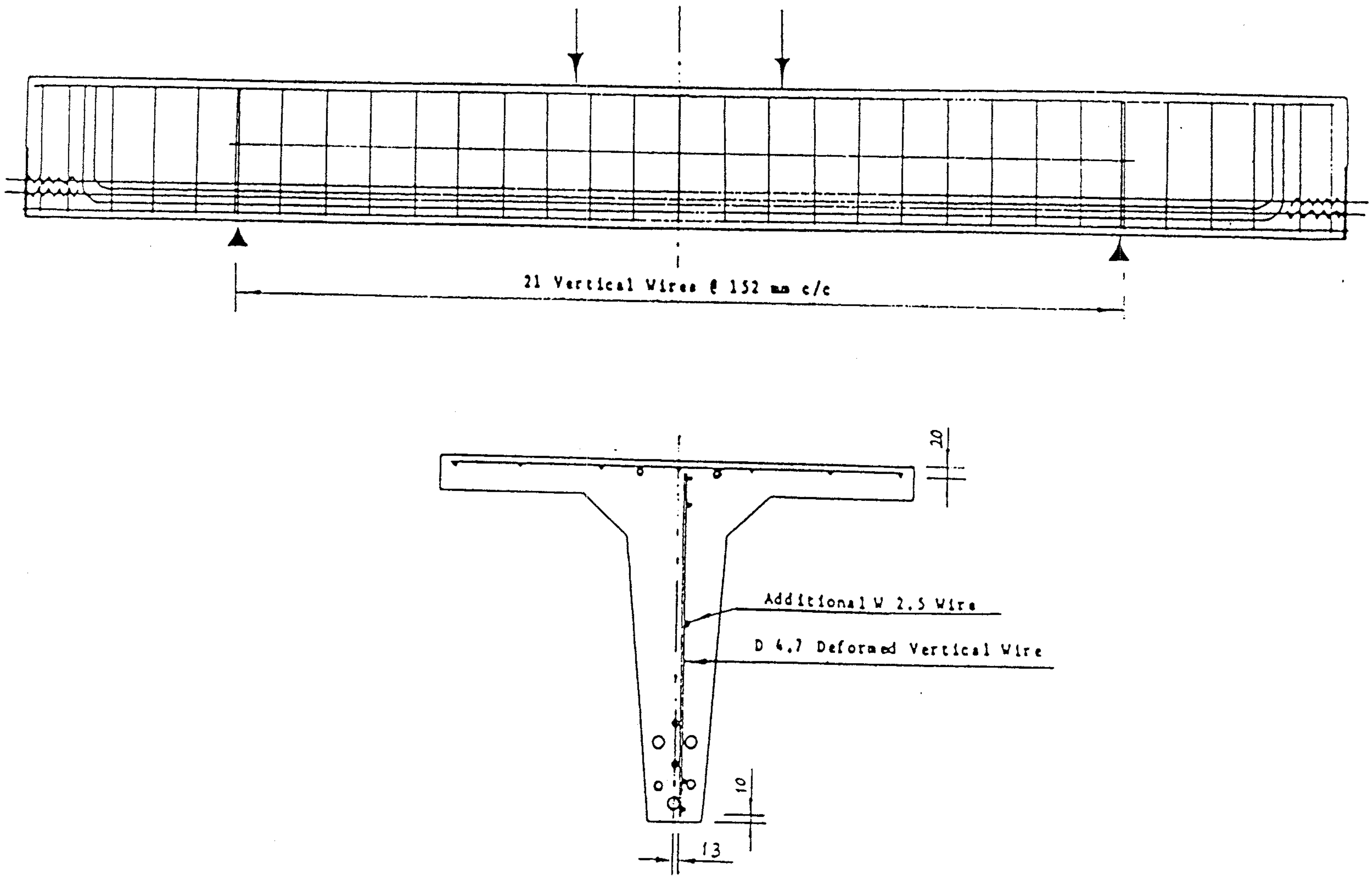


Figure 3.9 Beam PSN4-WDH with Deformed WWF with Additional Horizontal Wire

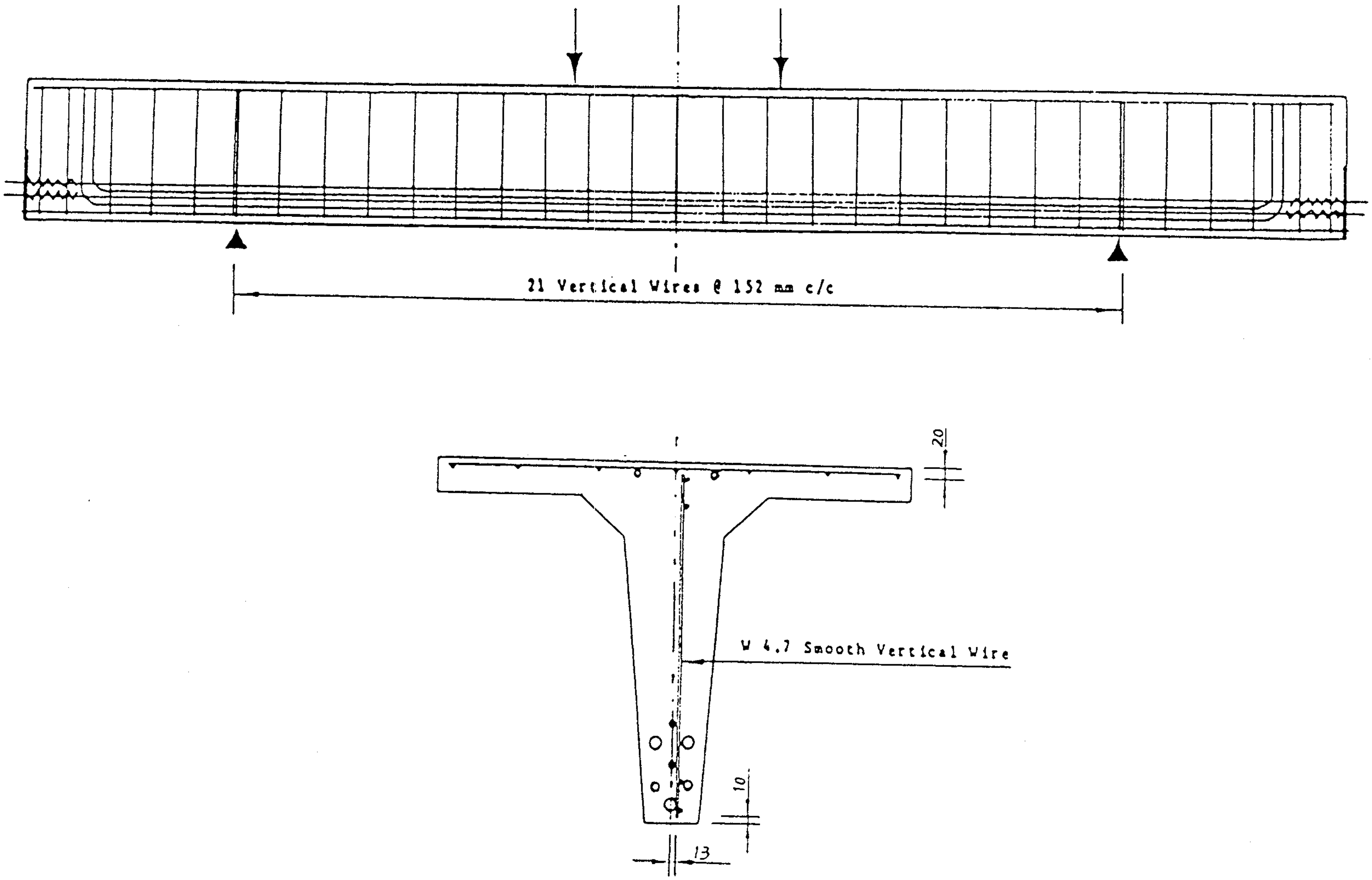


Figure 3.10 Beam PSN6-WS with Smooth WWF

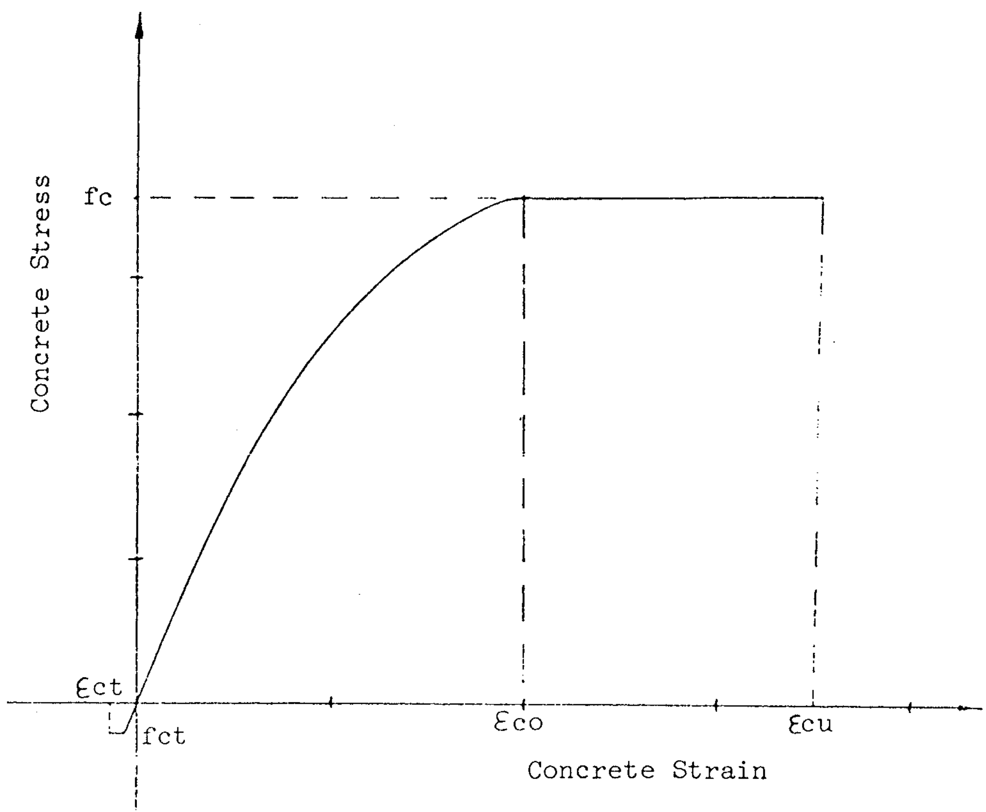


Figure 3.11 Idealized Concrete Stress-Strain Curve

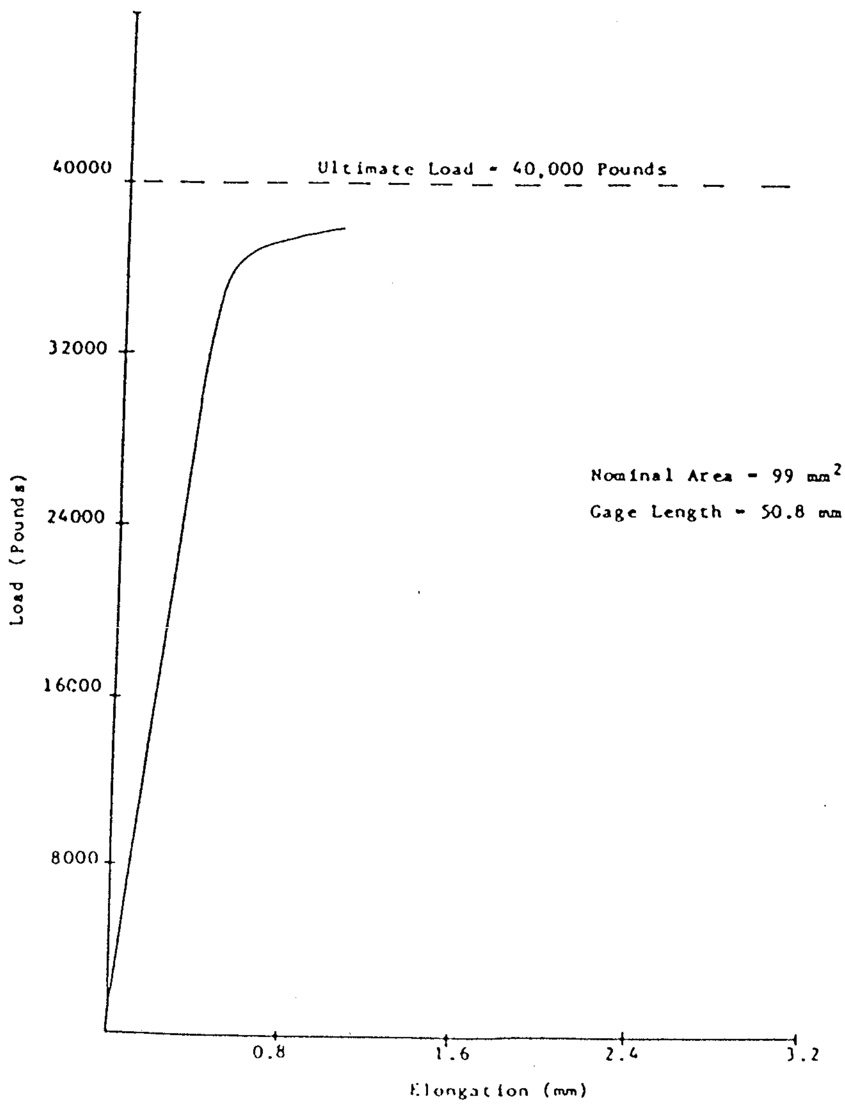


Figure 3.12 Load-elongation Curve for Prestress Strand

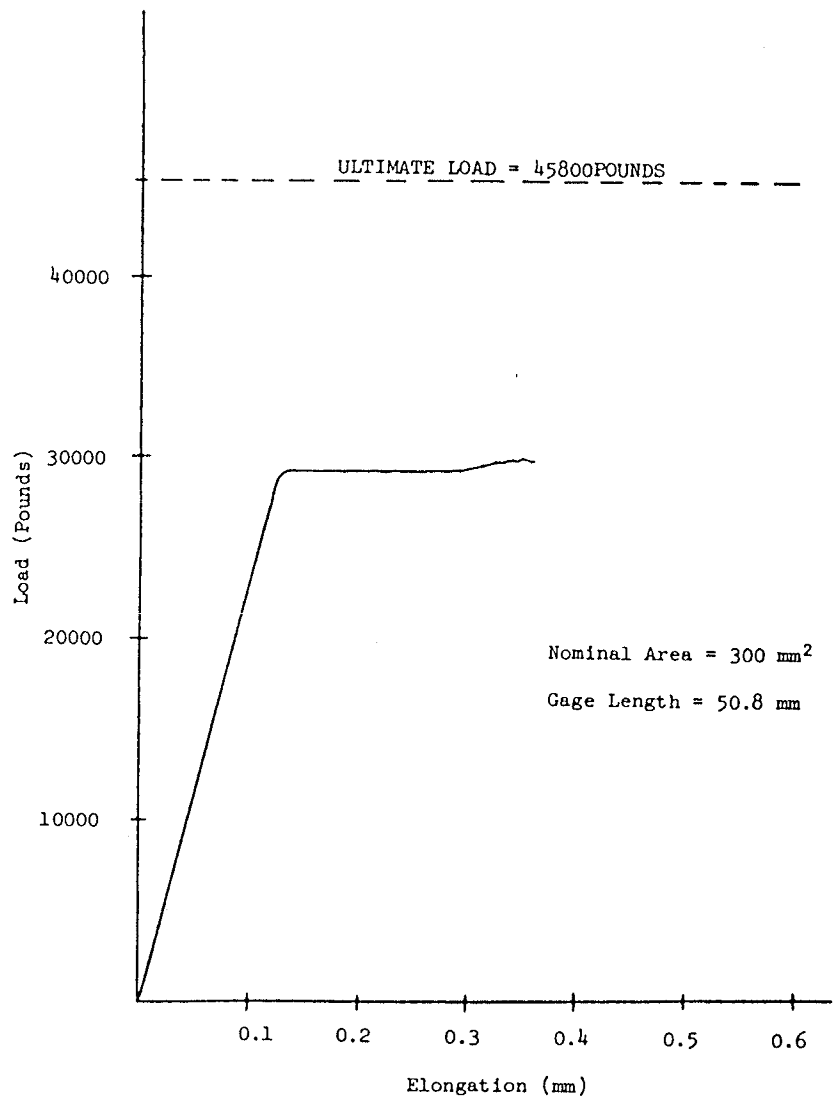


Figure 3.13 Load-elongation Curve for 20M Deformed Bar

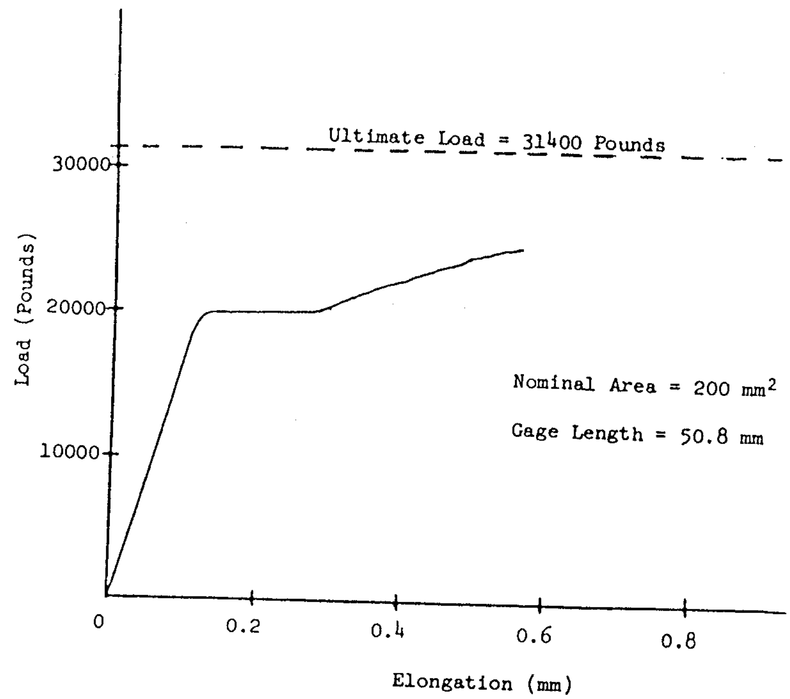


Figure 3.14 Load-elongation Curve for 15M Deformed Bar

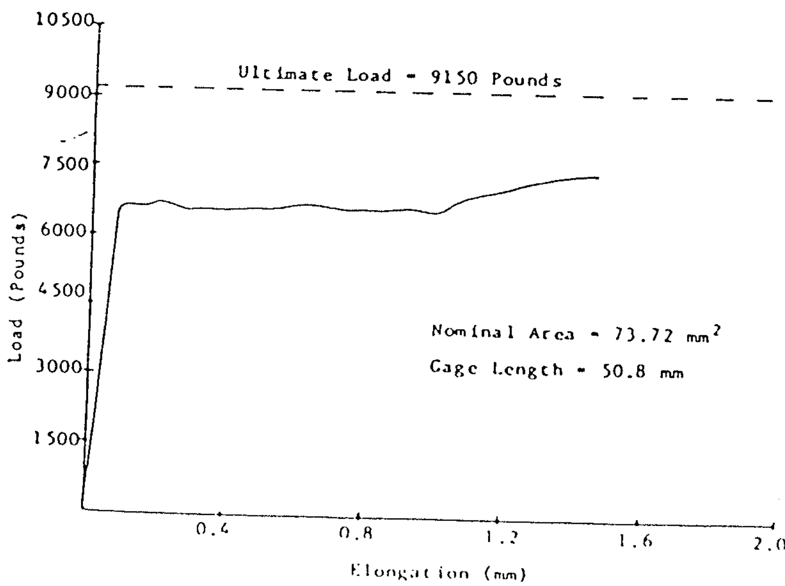


Figure 3.15 Load-elongation Curve for #3 Deformed Bar

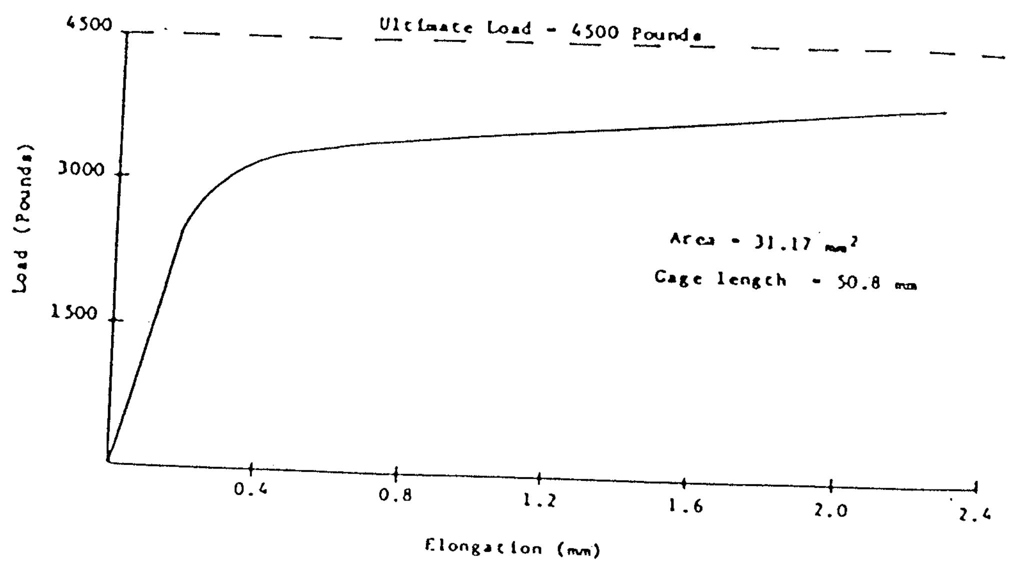


Figure 3.16 Load-elongation Curve for 6 mm Deformed Bar

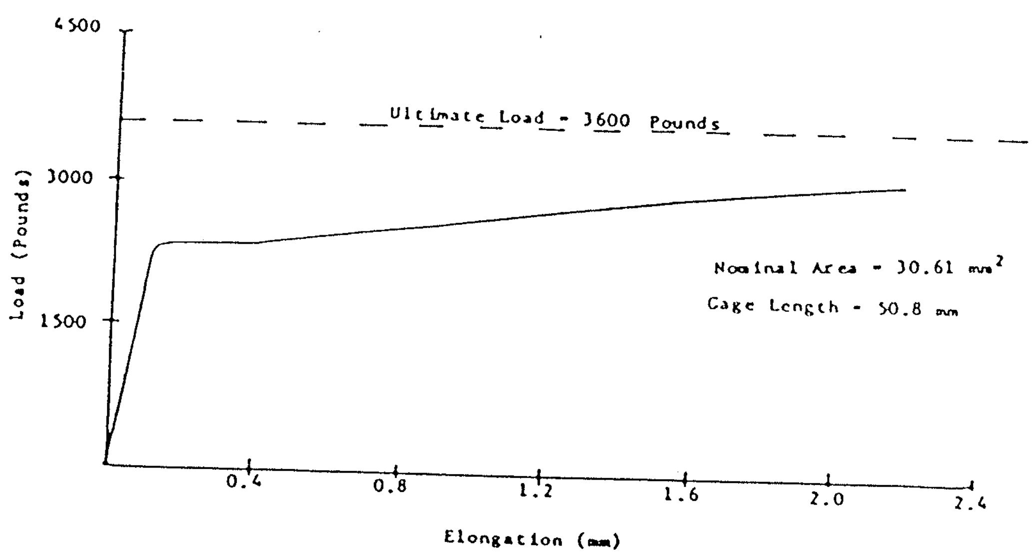


Figure 3.17 Load-elongation Curve for #2 Smooth Bar

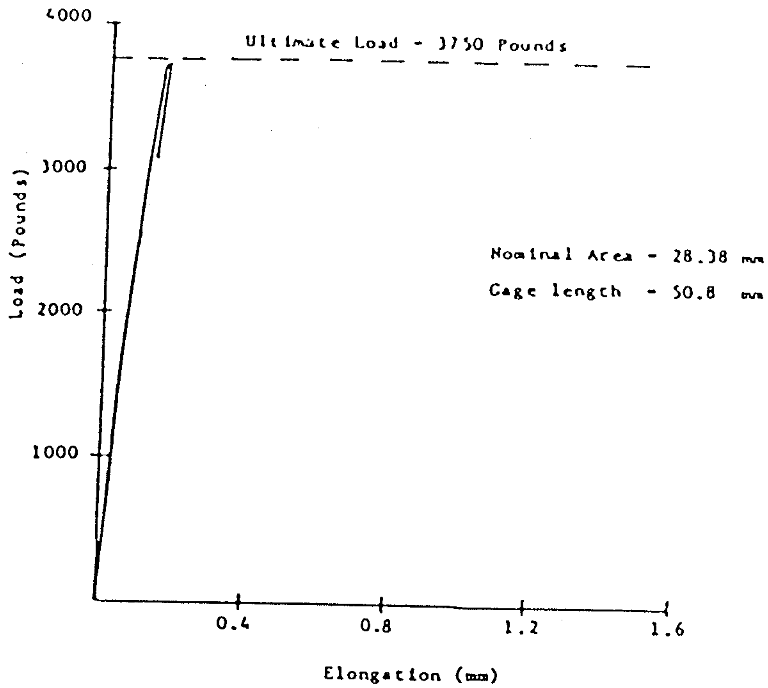


Figure 3.18 Load-elongation Curve for D4.7 Deformed Wire

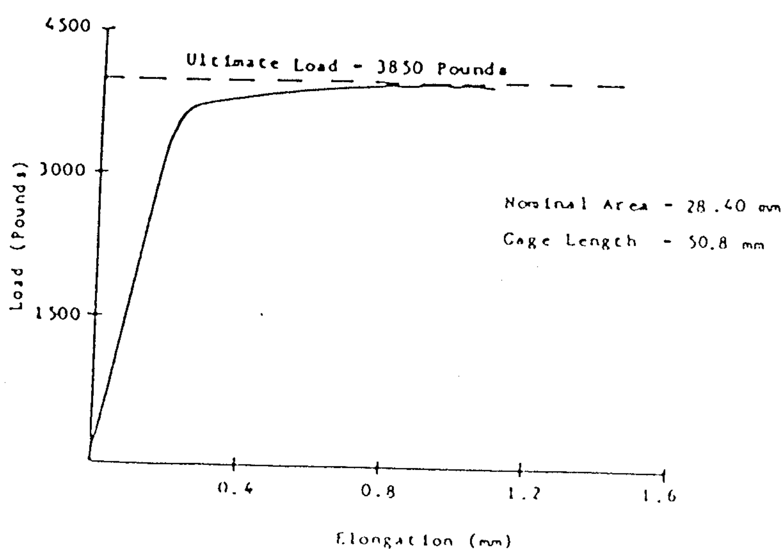


Figure 3.19 Load-elongation Curve for D4.7 Deformed Wire with Additional Horizontal Wire

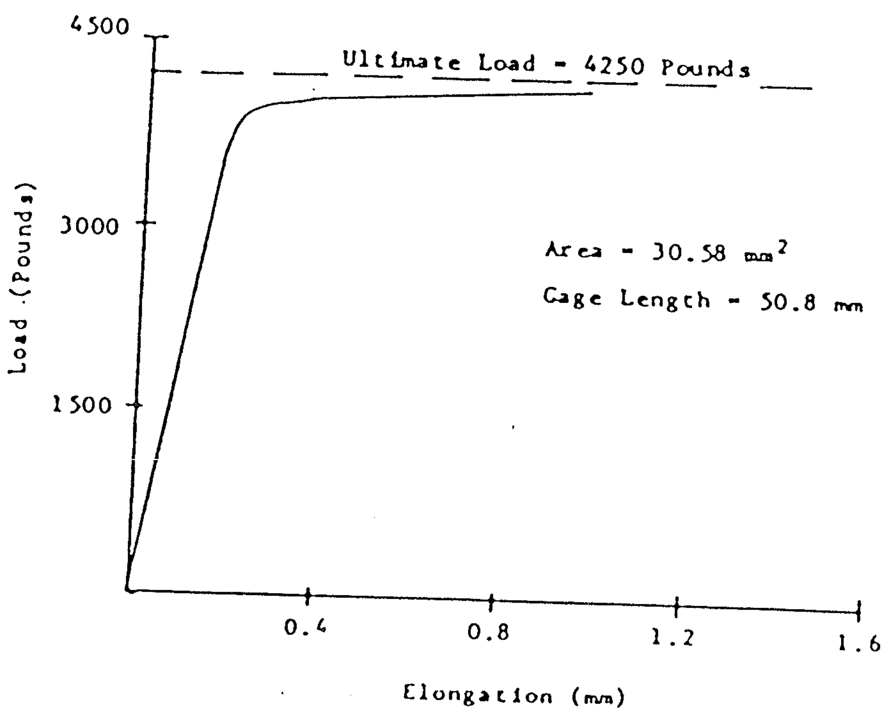
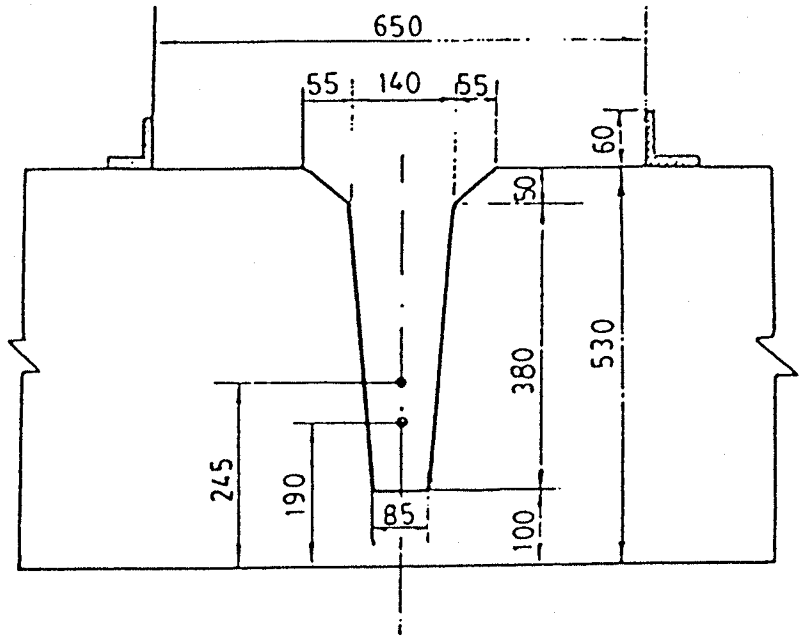


Figure 3.20 Load-elongation Curve for W4.7 Smooth Wire



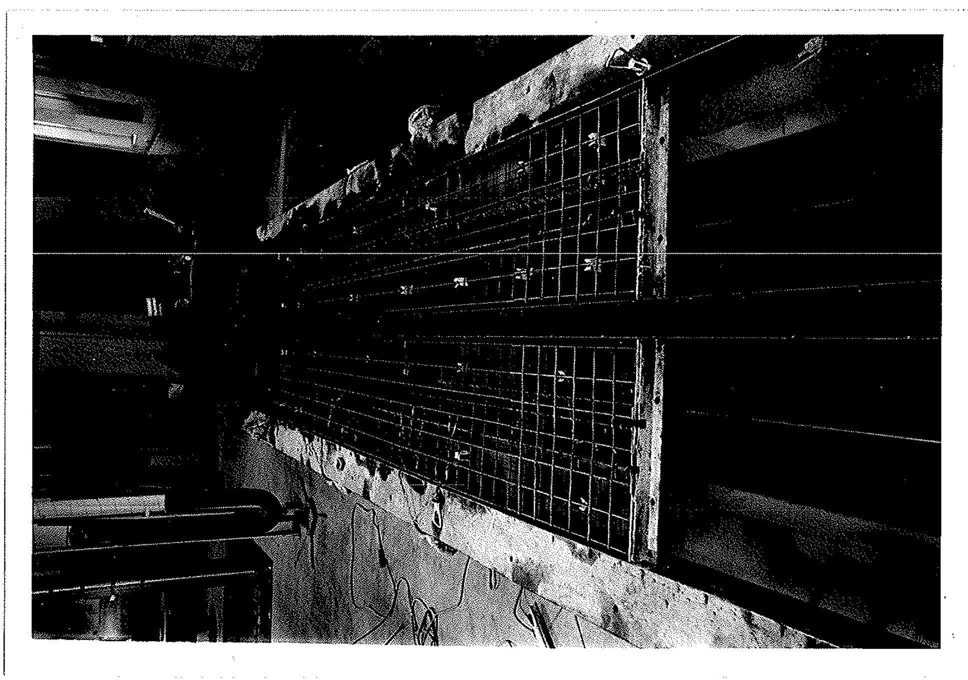
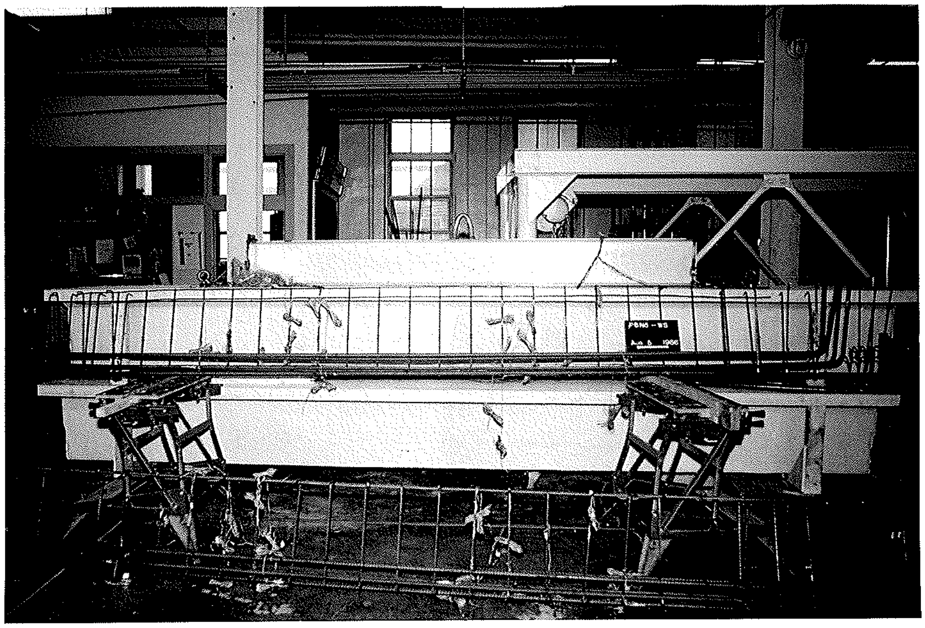


Figure 3.21 Steel Form for Casting of Two Beams



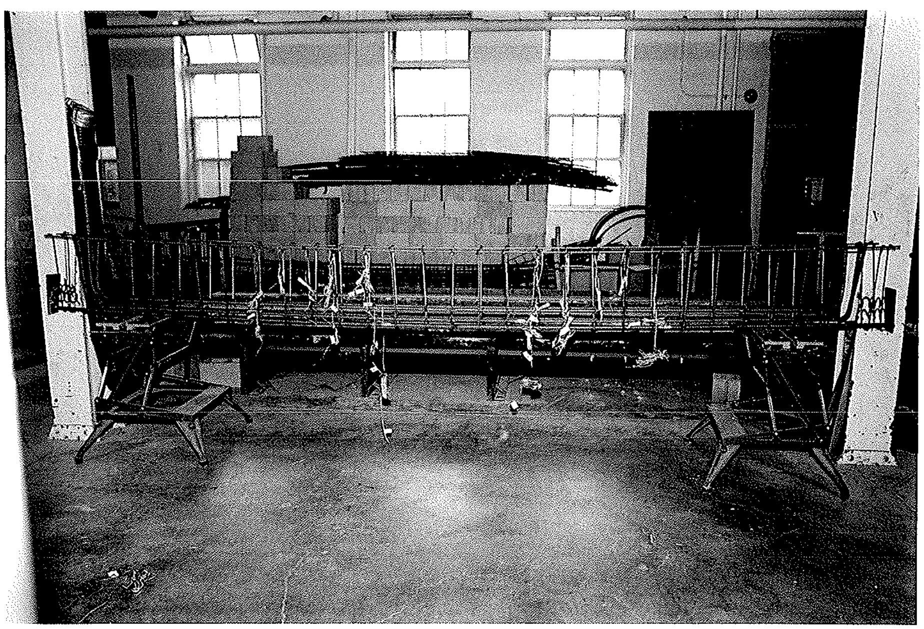
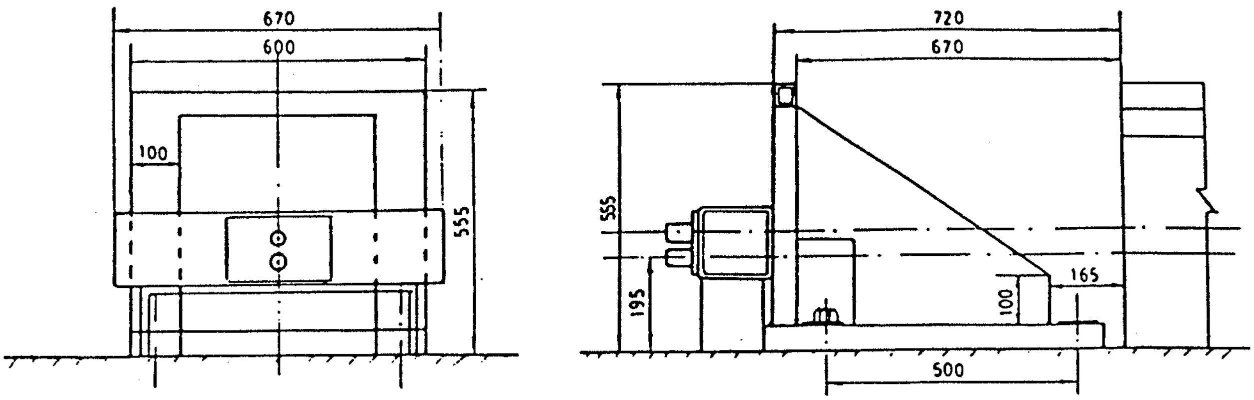


Figure 3.22 Typical Reinforcement Cages



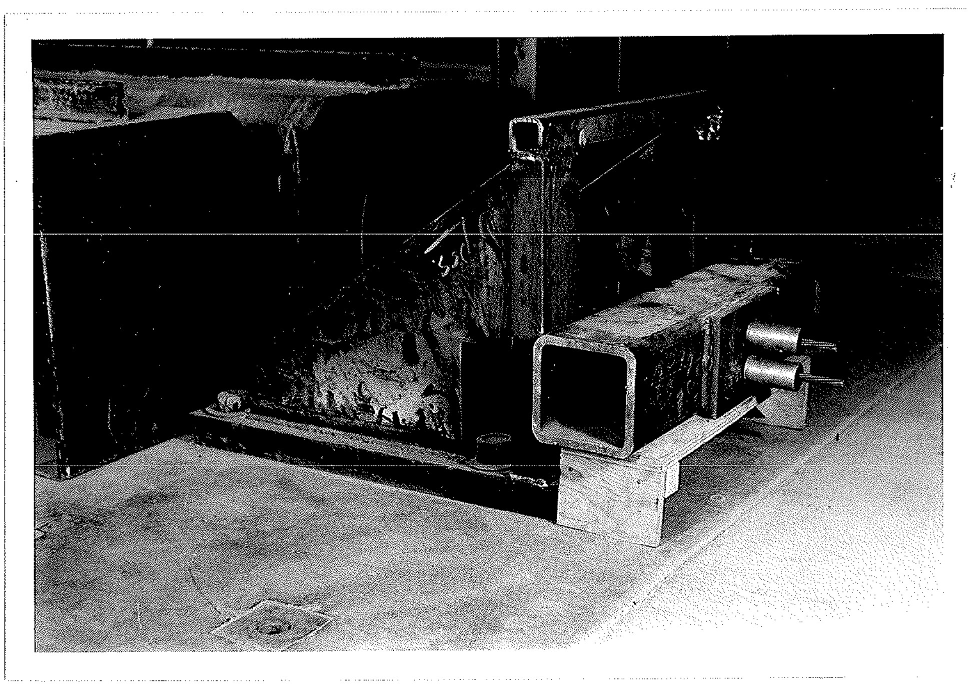
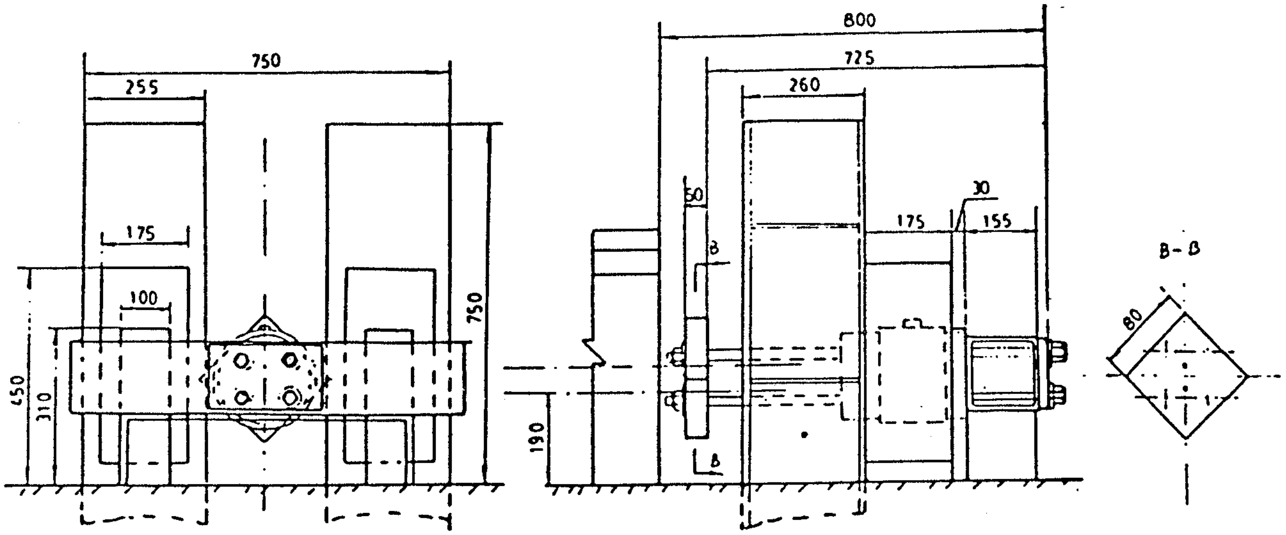


Figure 3.23 Abutment for Prestressing Strands in South



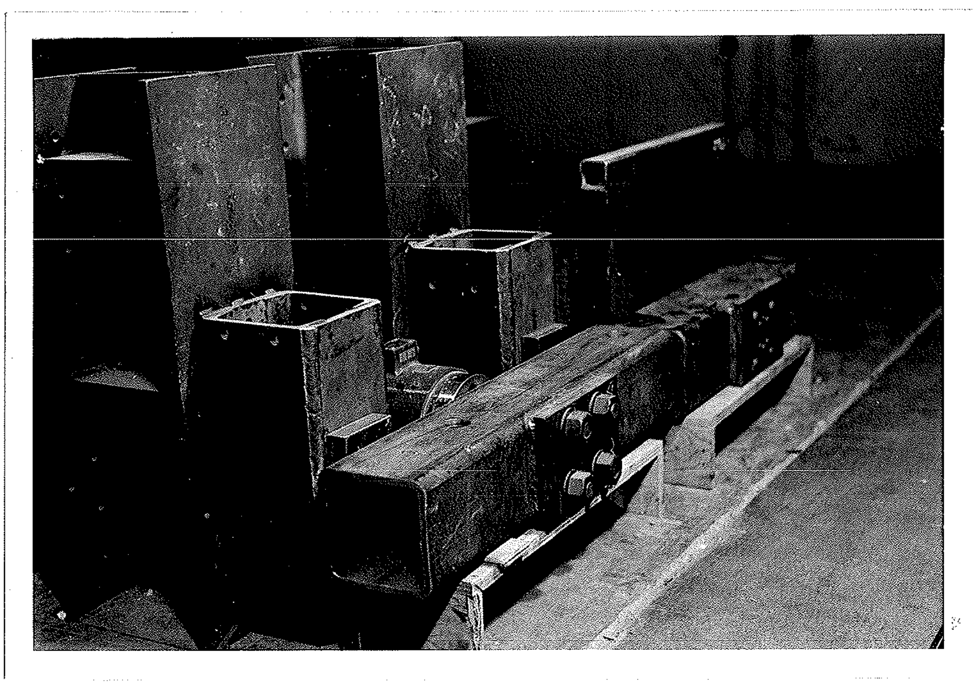


Figure 3.24 Abutment for Prestressing Strands in North

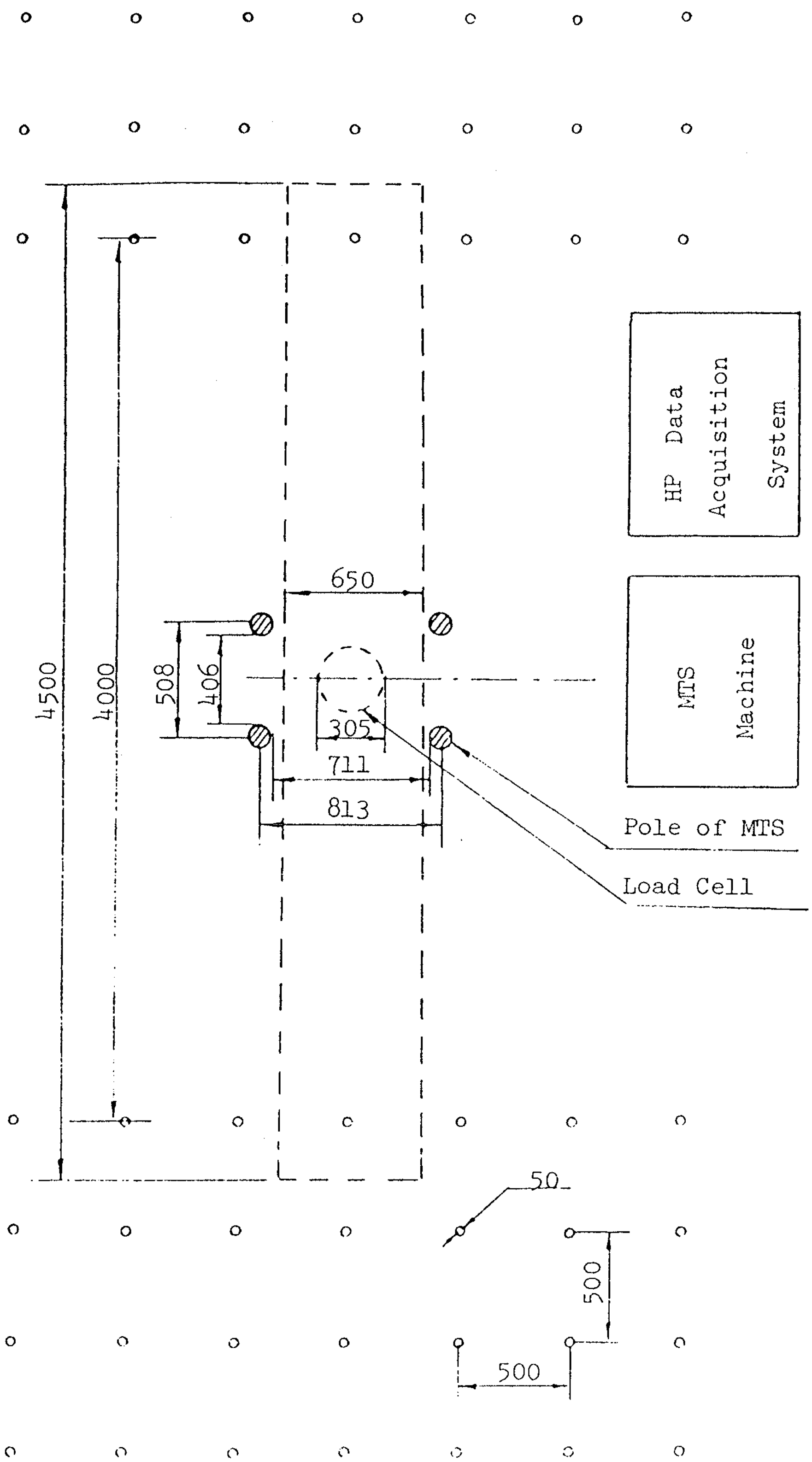
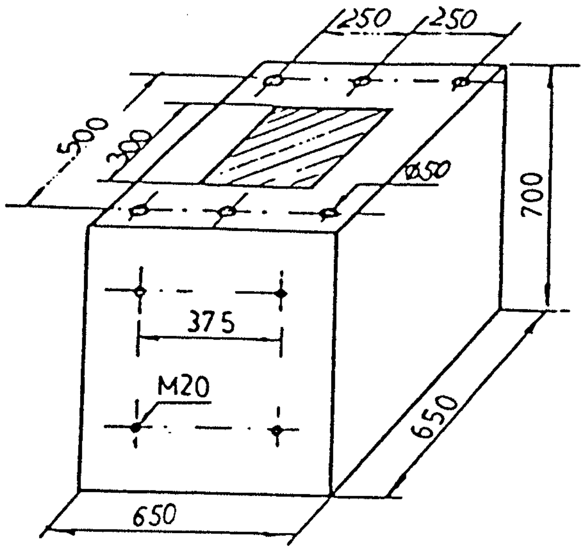
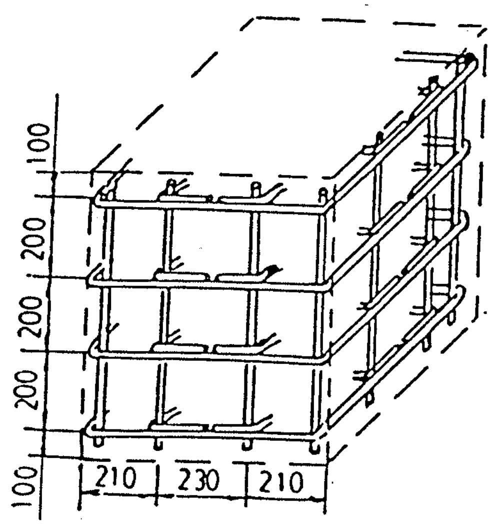


Figure 3.25 Testing Floor





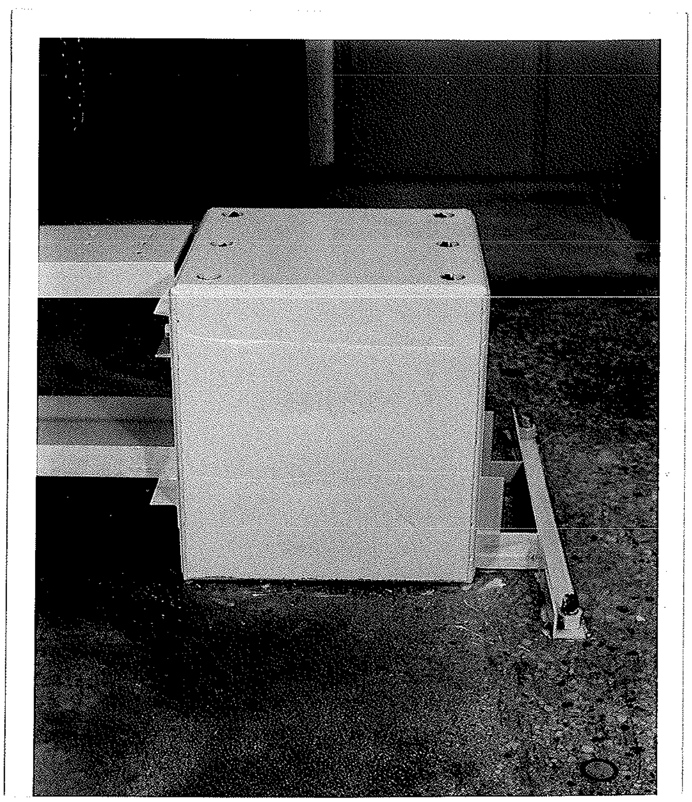
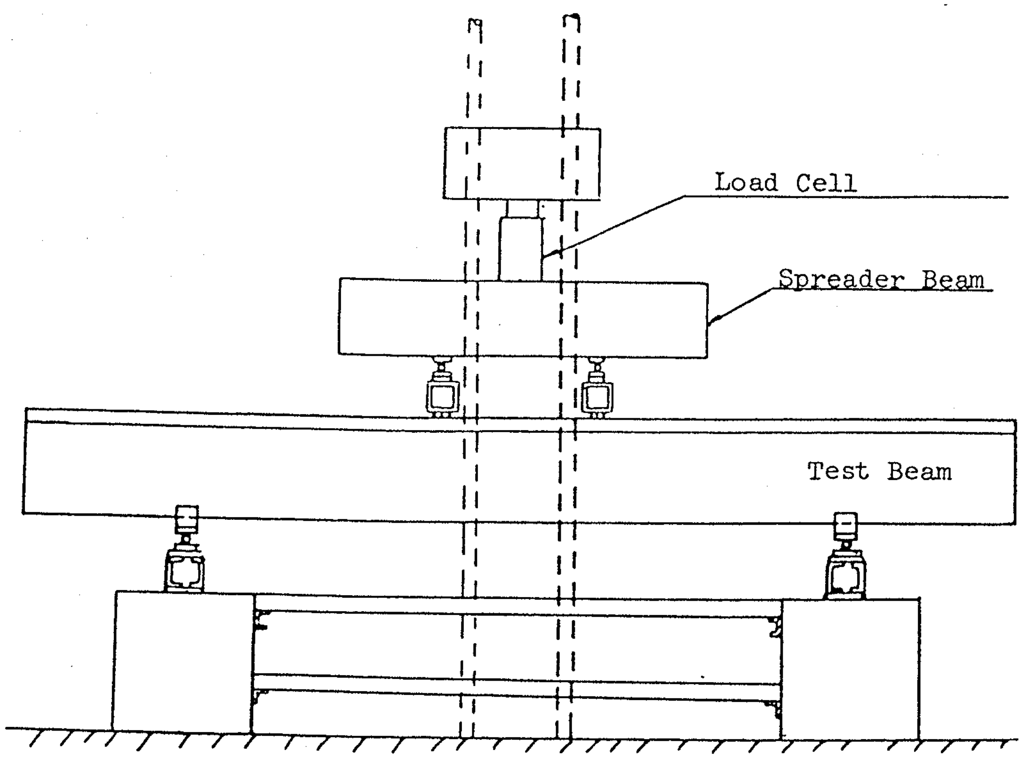


Figure 3.26 Concrete Block at Support



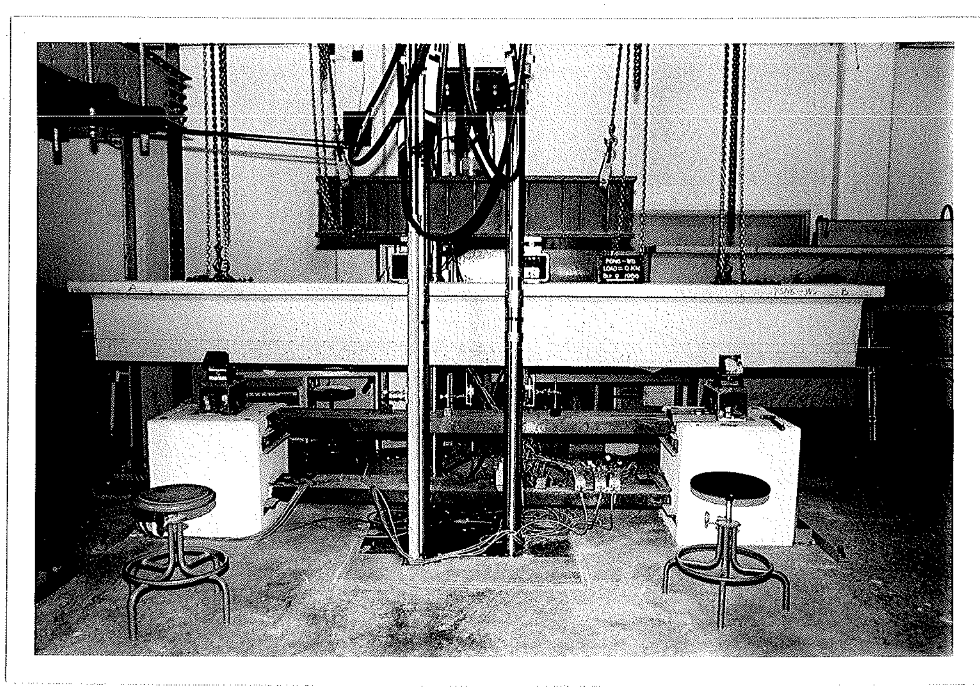


Figure 3.27 Test Set-Up

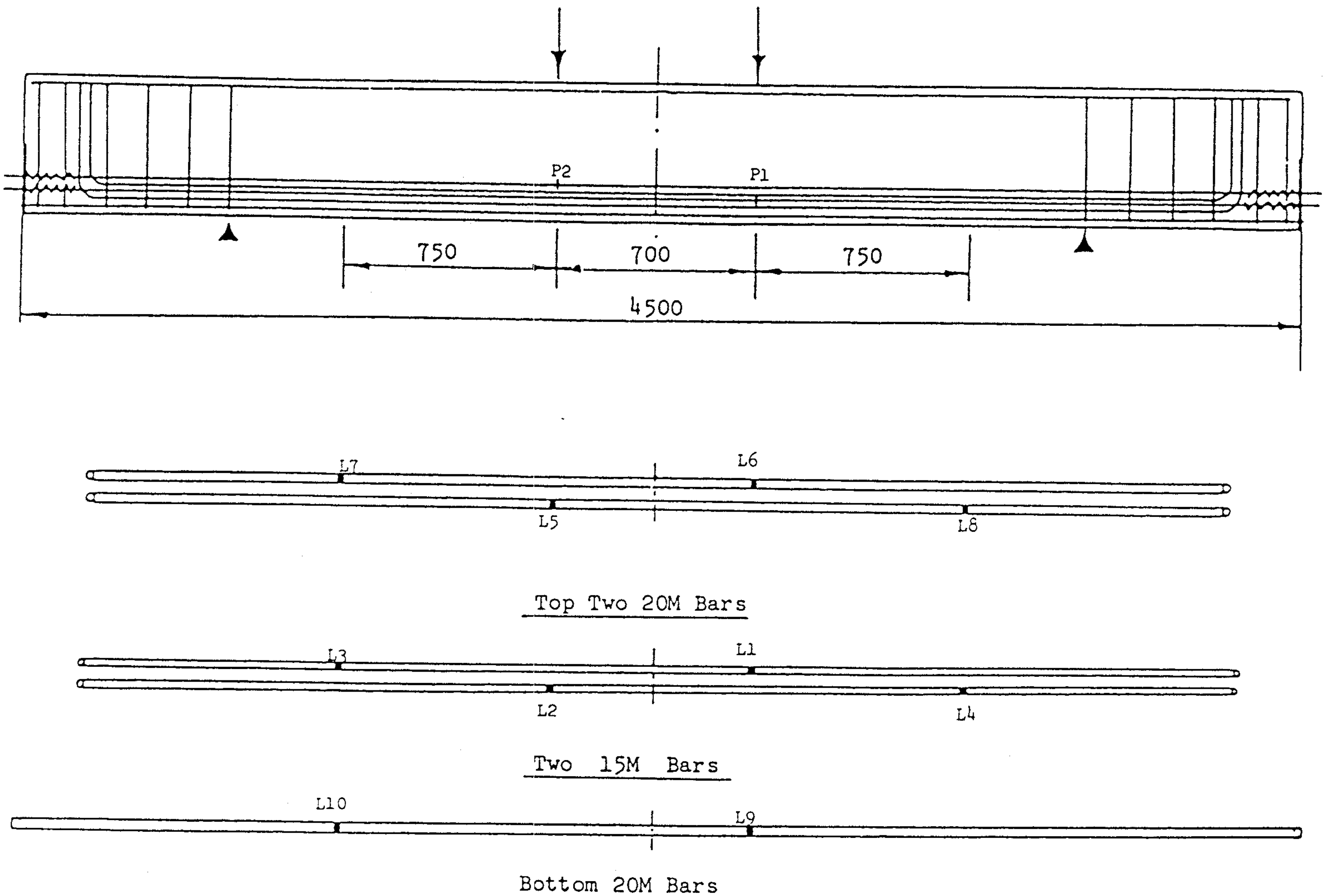


Figure 3.28 Electrical Strain Gage Locations in Beam PSN1-0

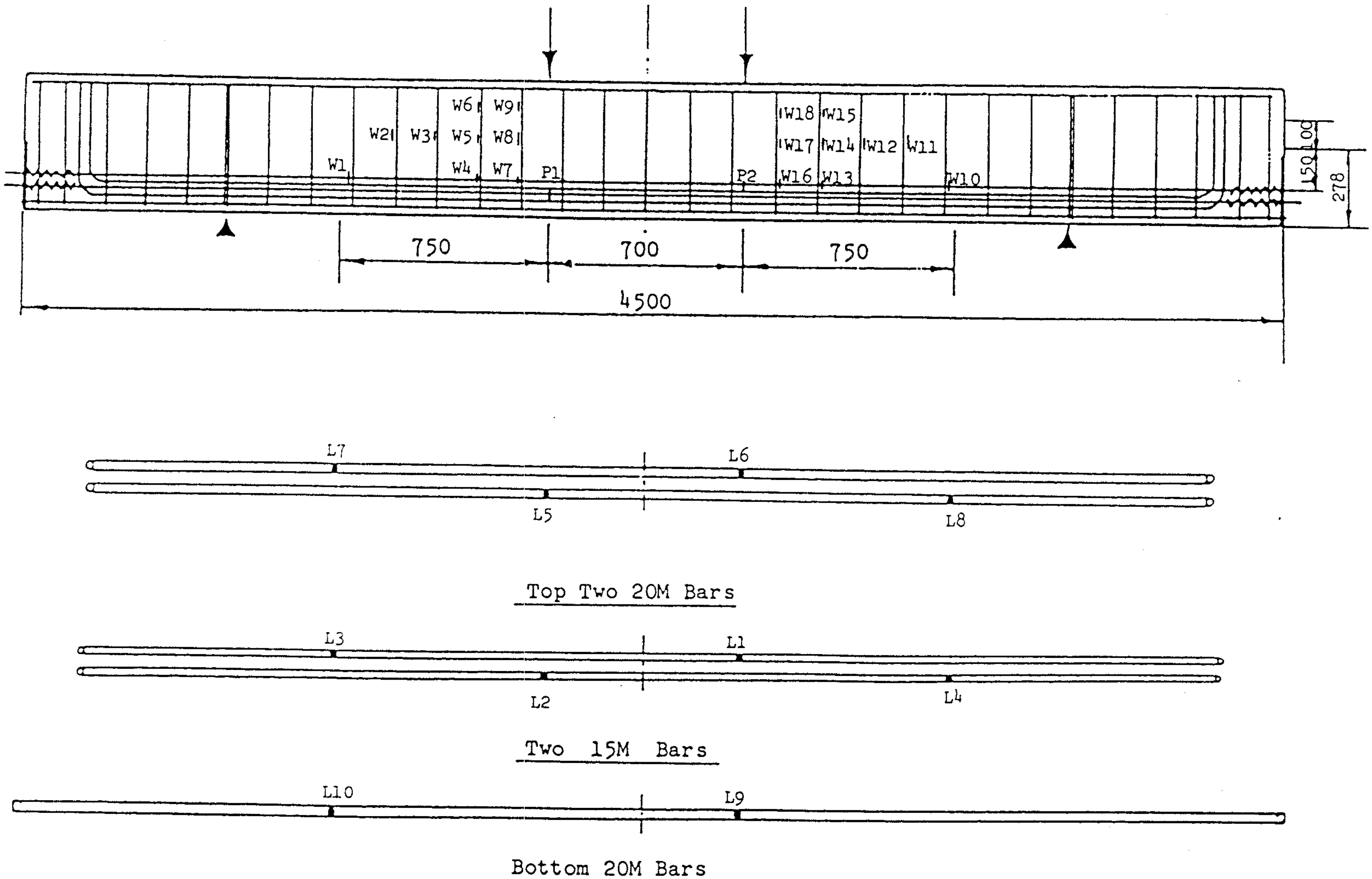


Figure 3.29 Electrical Strain Gage Locations in Beam PSN2-WD

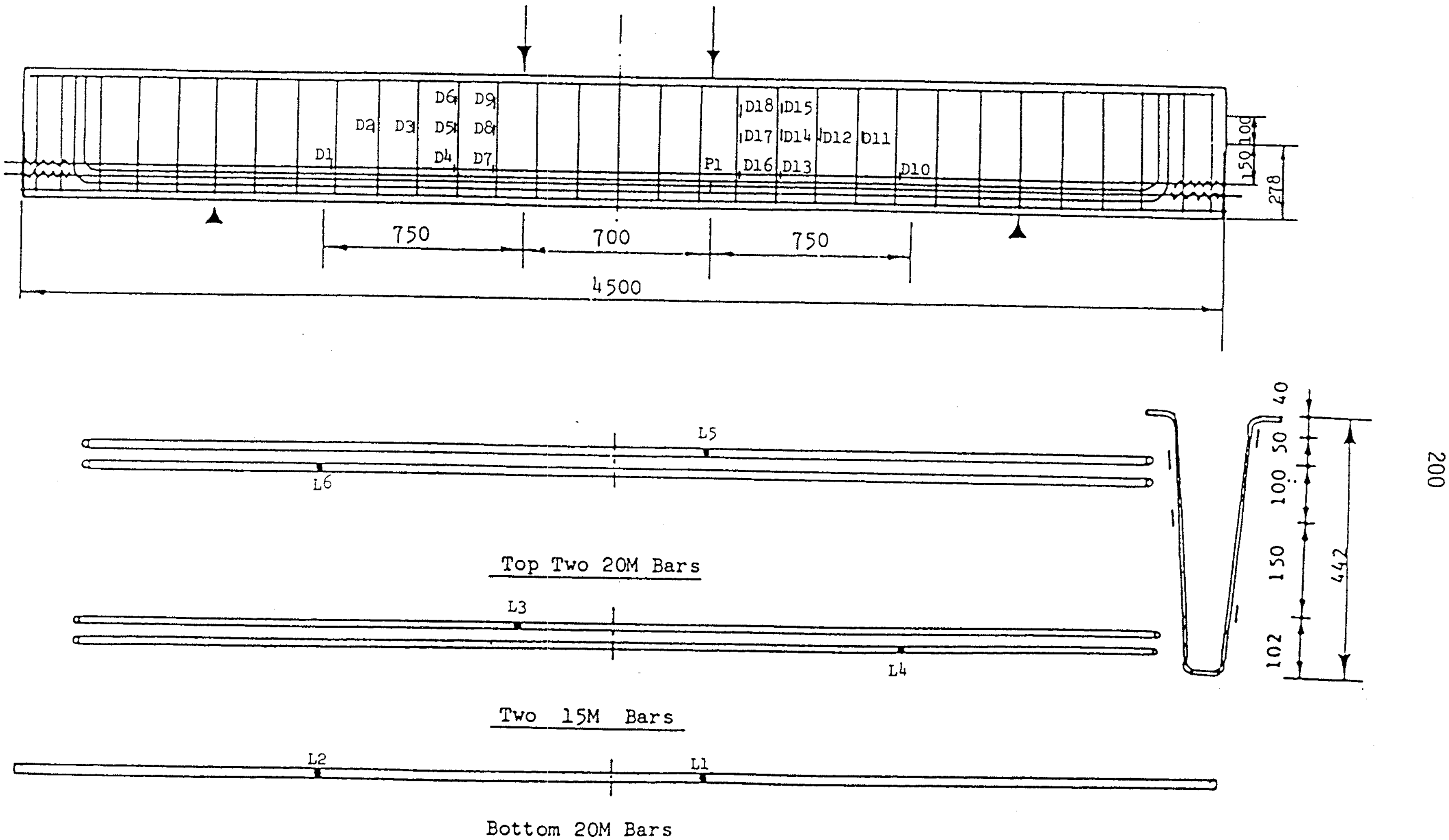
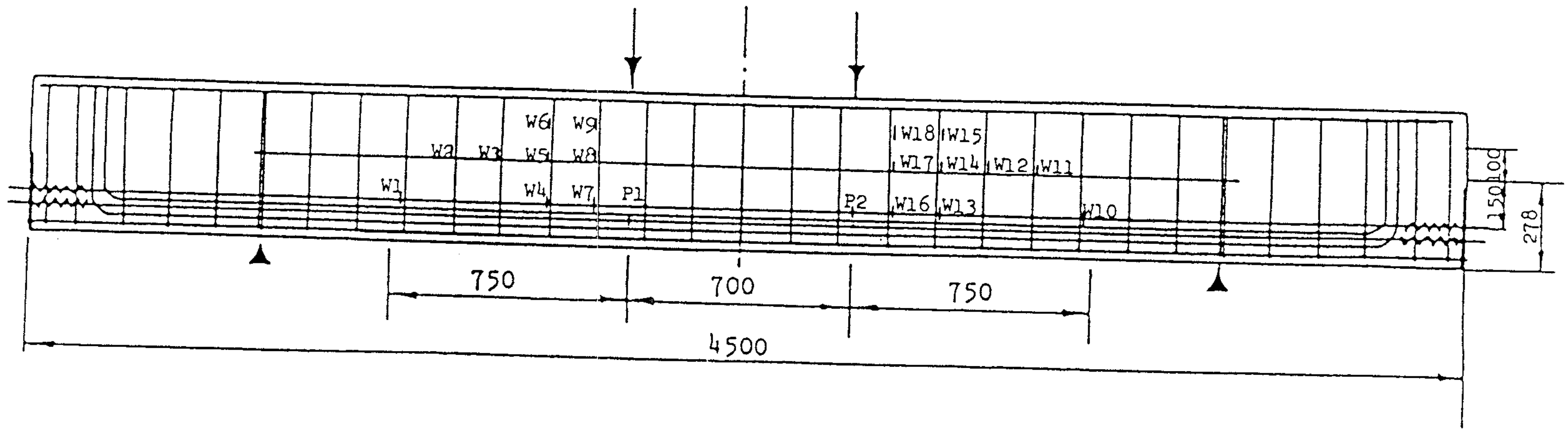
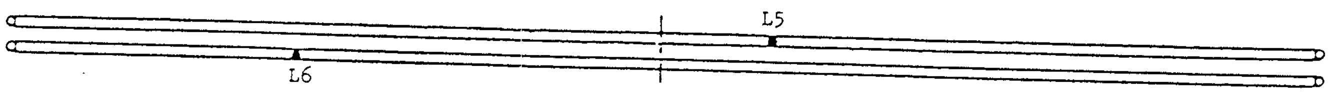
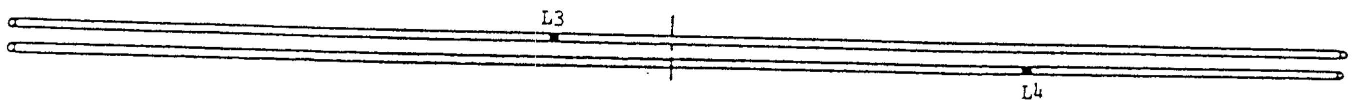


Figure 3.30 Electrical Strain Gage Locations in Beam PSN3-D2

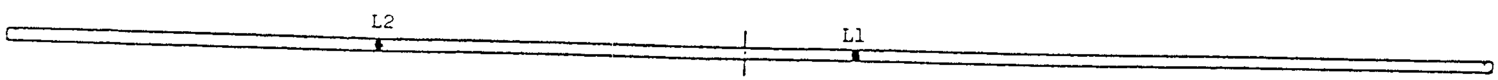




Top Two 20M Bars



Two 15M Bars



Bottom 20M Bars

Figure 3.31 Electrical Strain Gage Locations in Beam PSN4-WDH

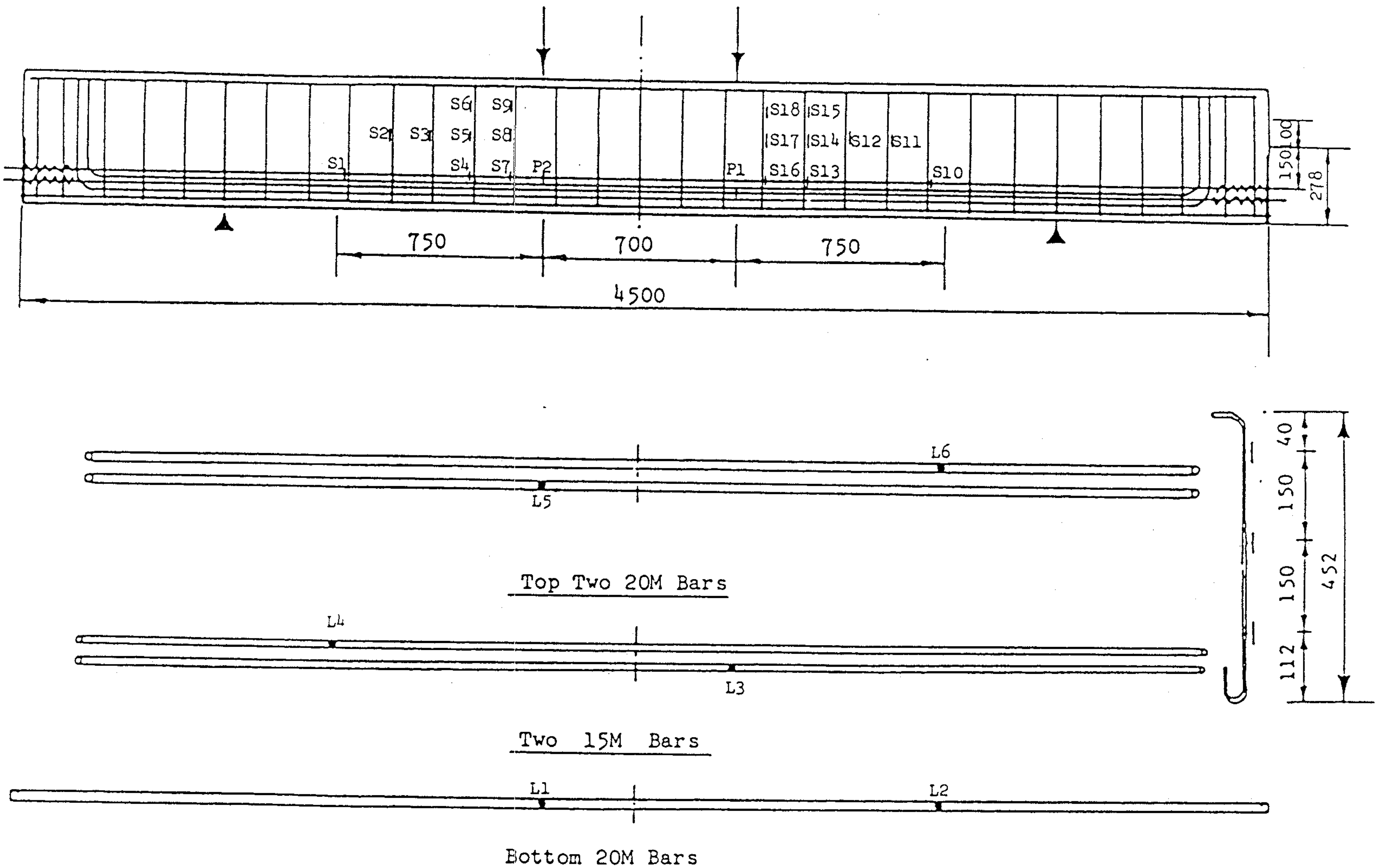


Figure 3.32 Electrical Strain Gage Locations in Beam PSN5-S6M

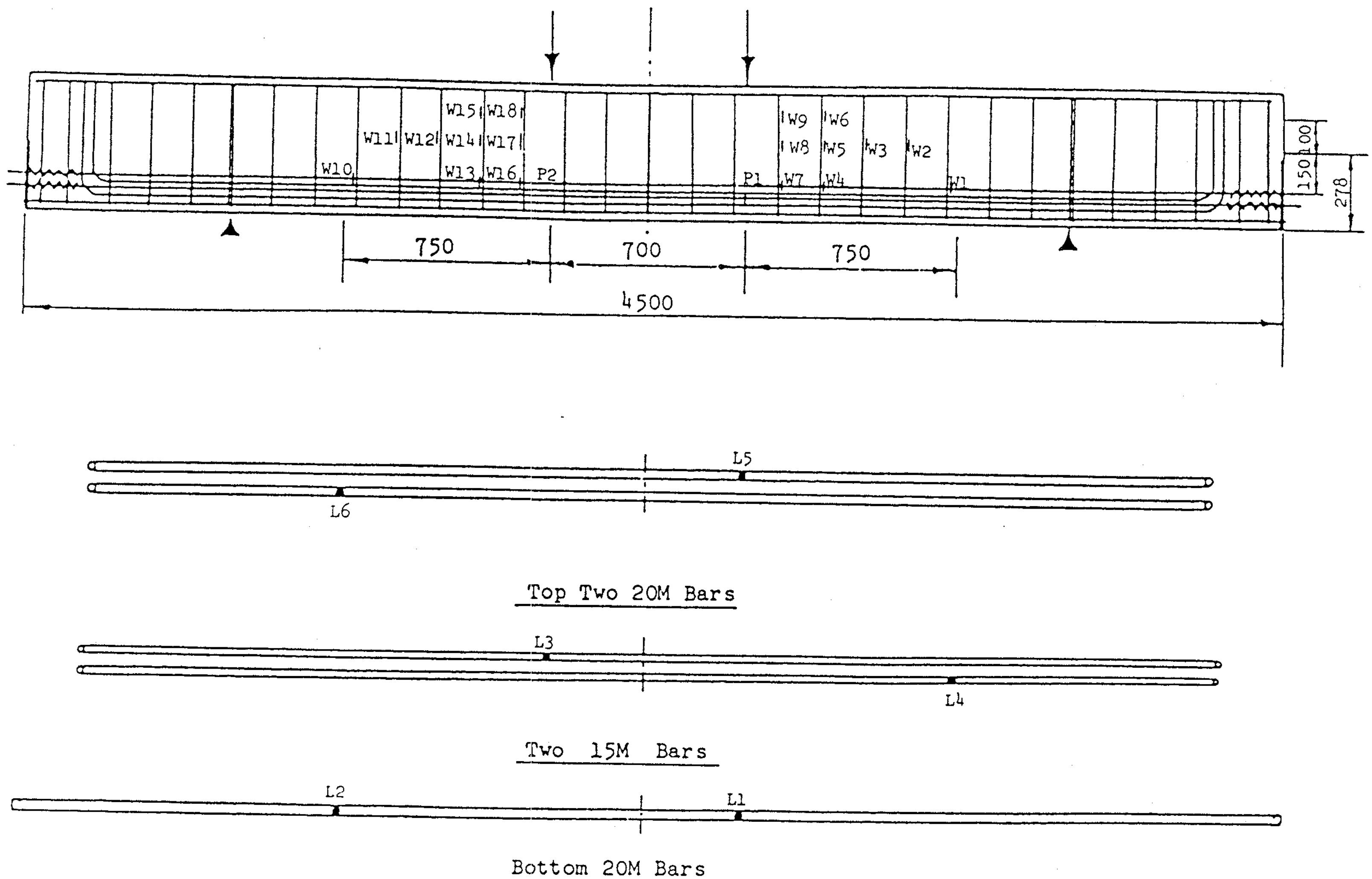


Figure 3.33 Electrical Strain Gage Locations in Beam PSN6-WS

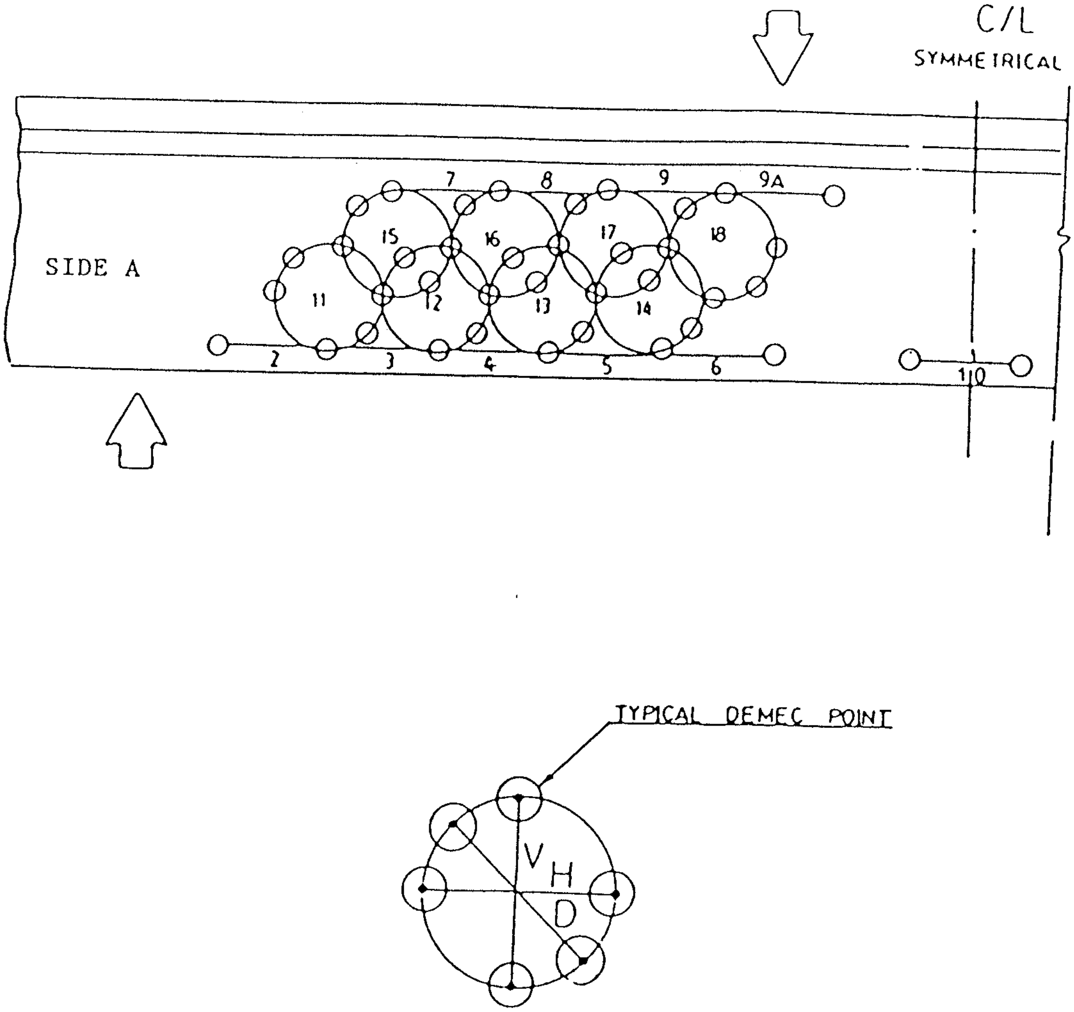


Figure 3.34 Demec Point Locations

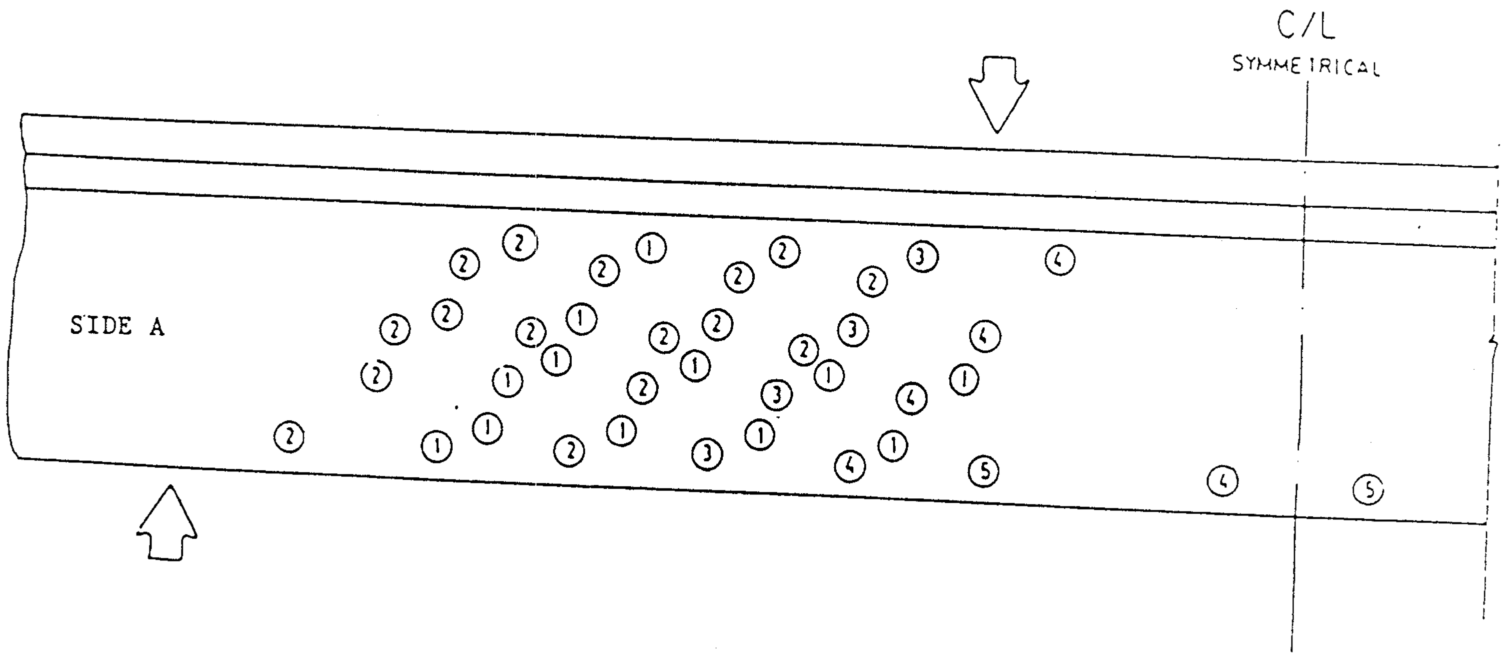


Figure 3.35 Instalment Sequence for Demec Point Locations

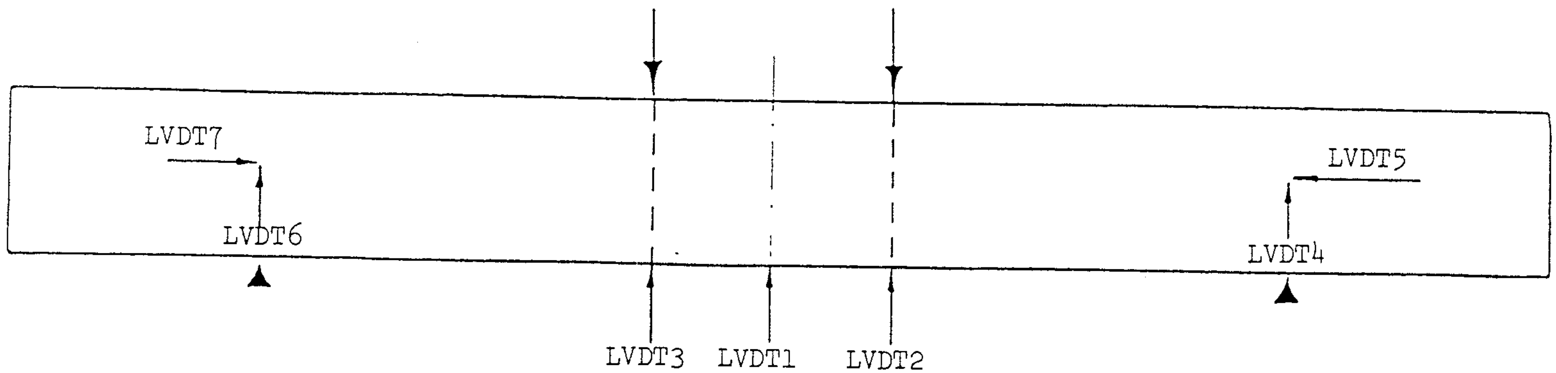


Figure 3.36 LVDT Locatinns

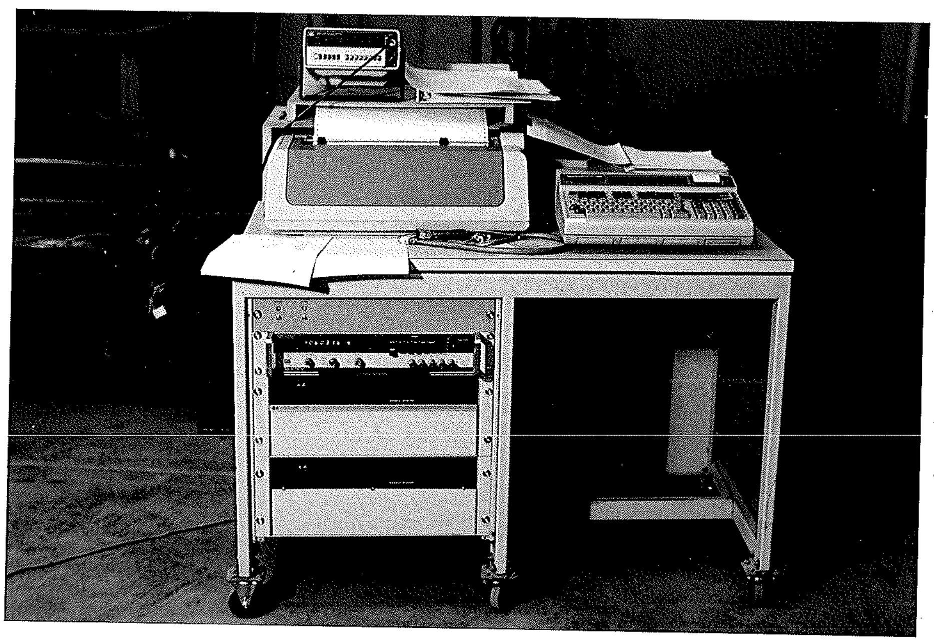


Figure 3.37 Data Acquisition System

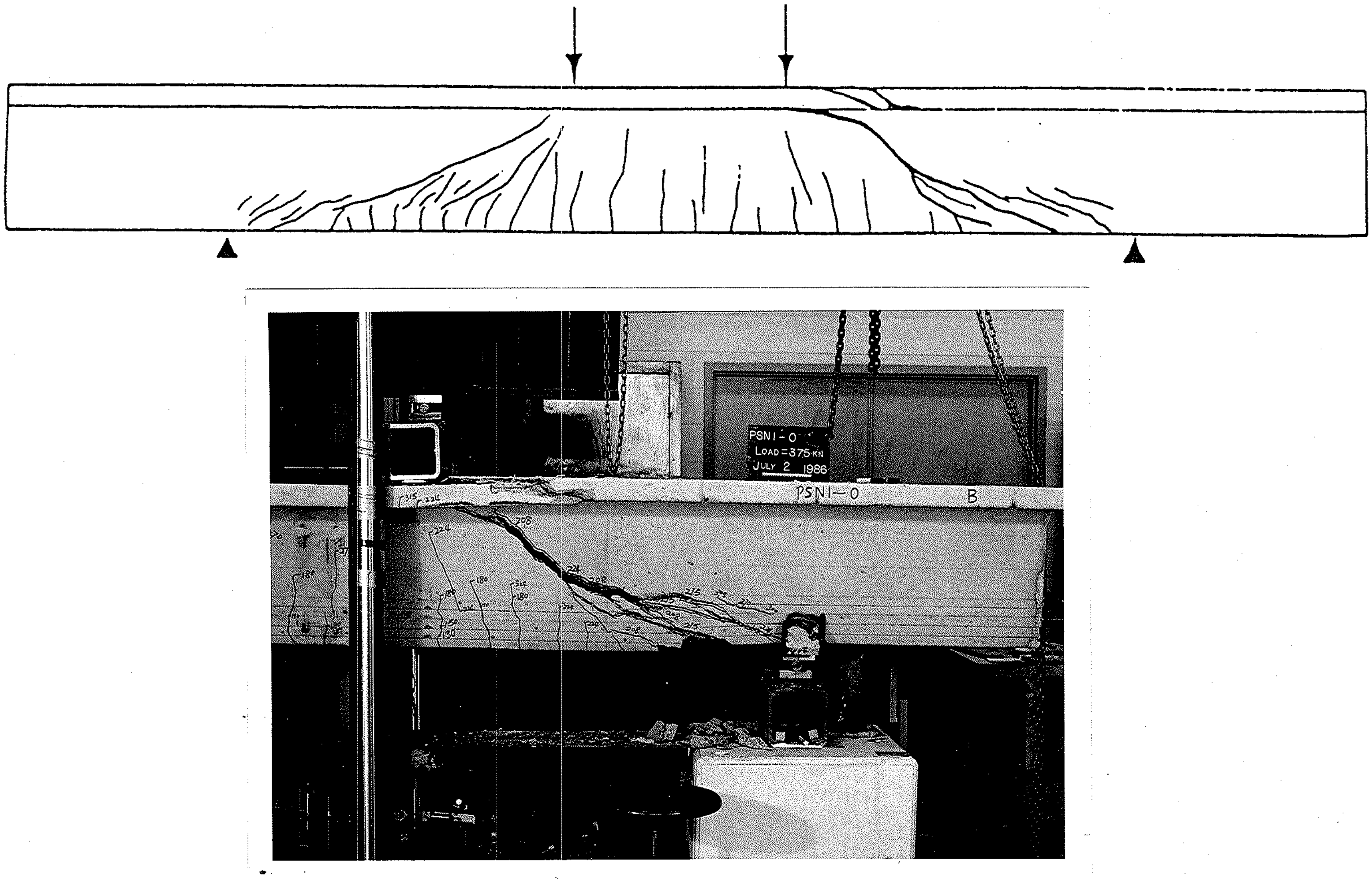
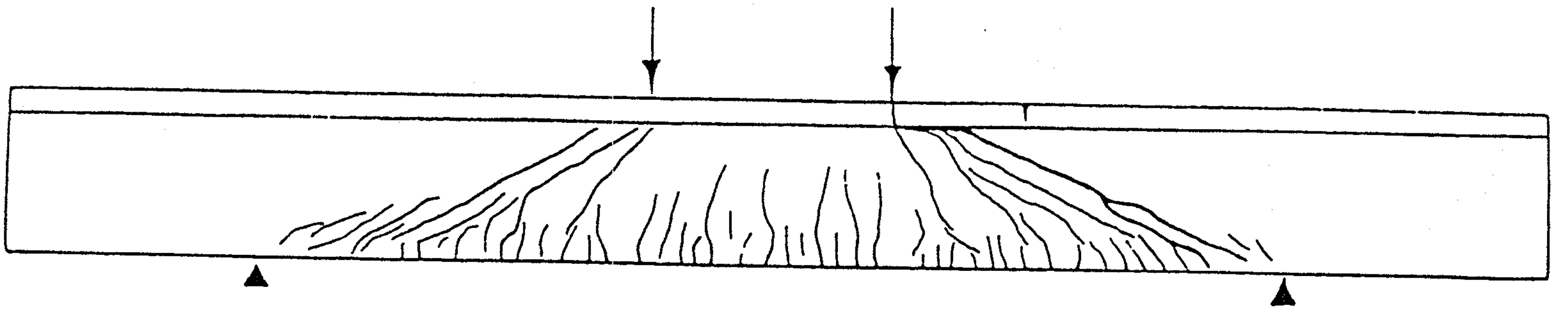


Figure 4.1-PSN1 Crack Pattern of Beam PSN1-0



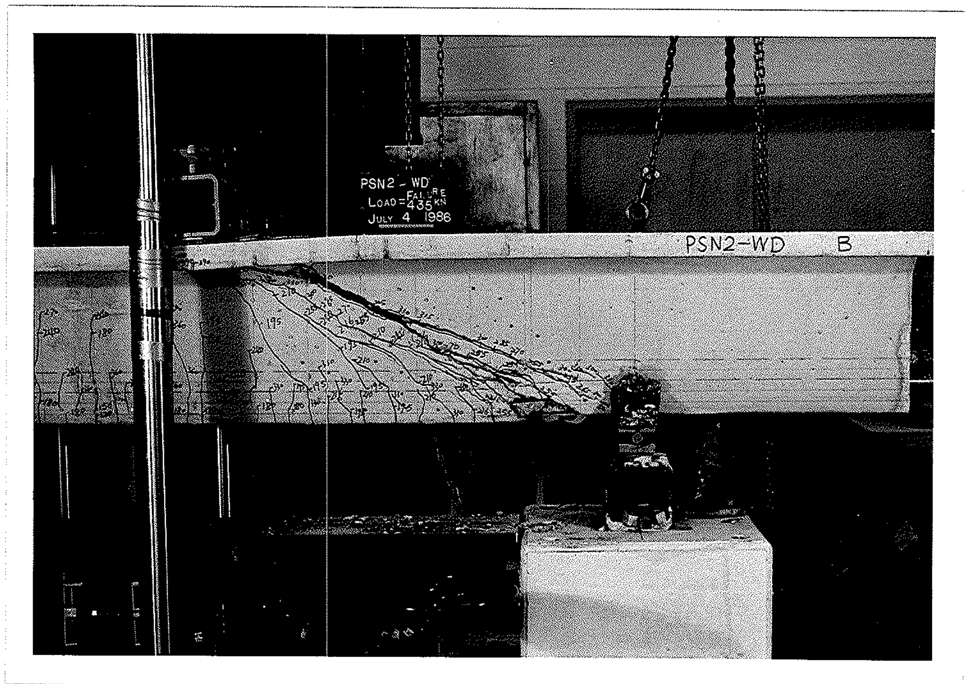


Figure 4.1-PSN2 Crack Pattern of Beam PSN2-WD

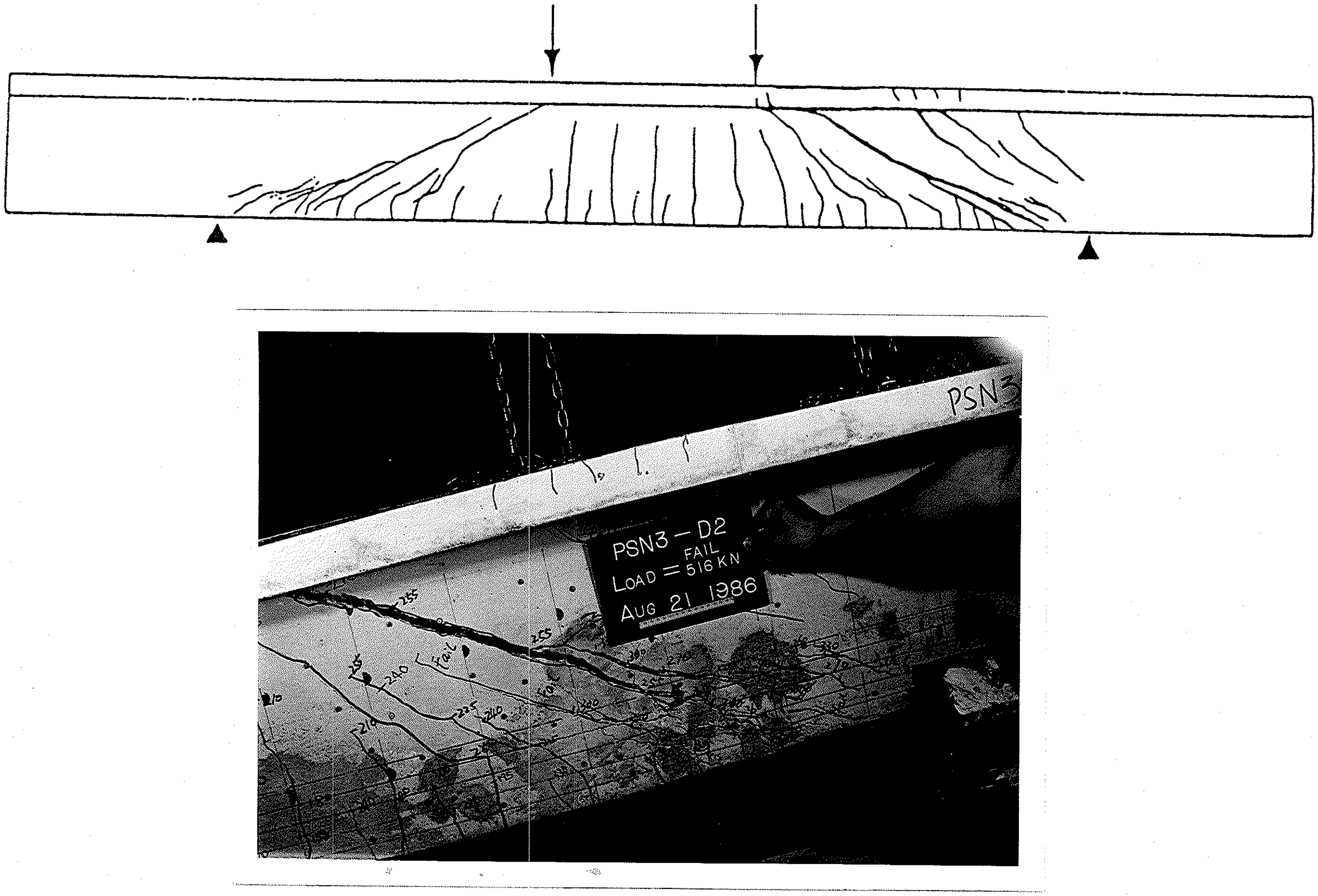


Figure 4.1-PSN3 Crack Pattern of Beam PSN3-D2

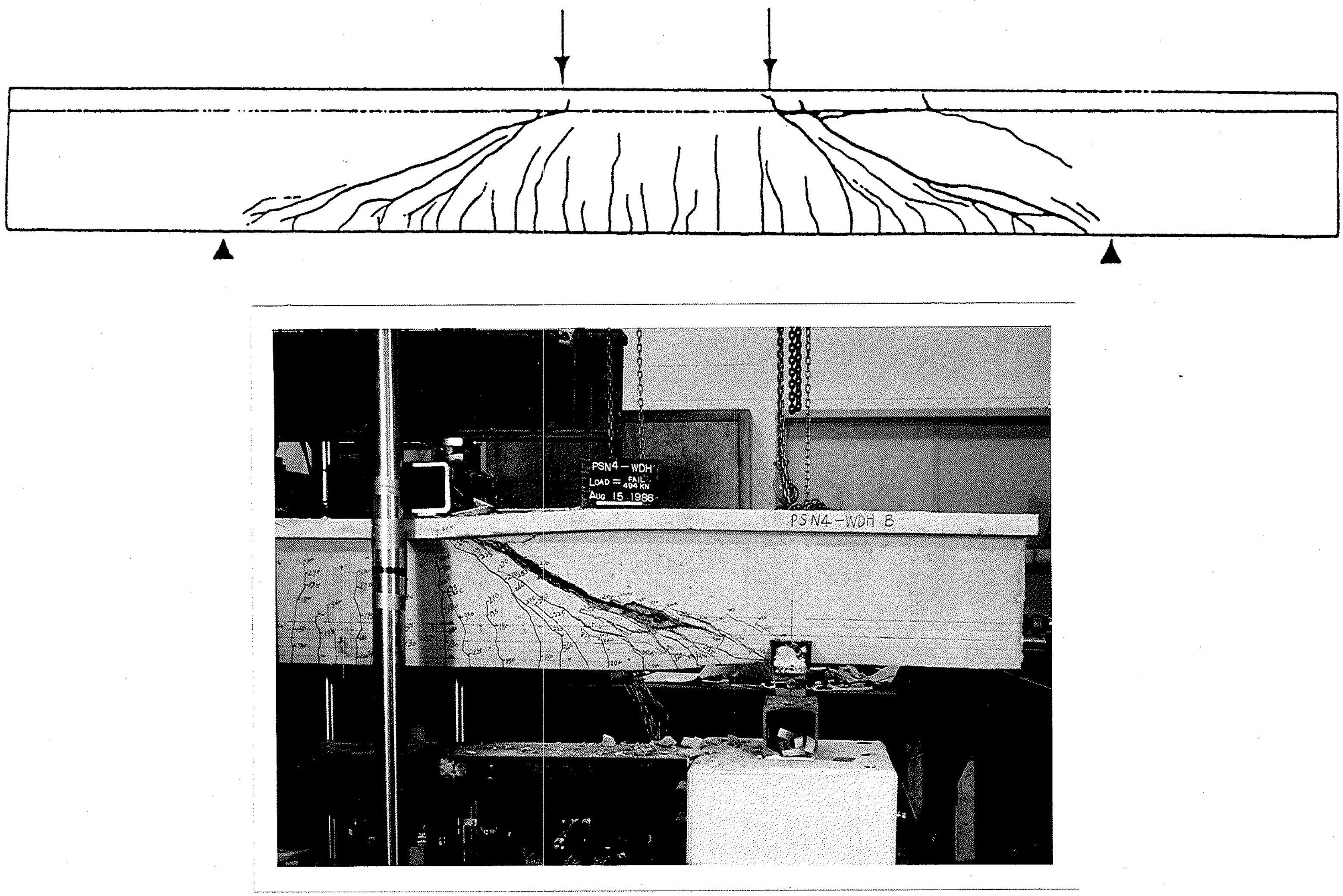
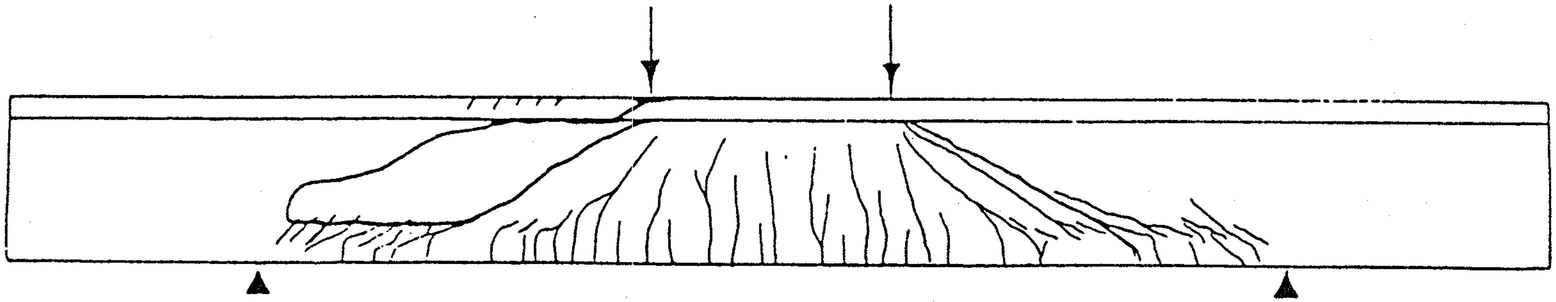


Figure 4.1-PSN4 Crack Pattern of Beam PSN4-WDH



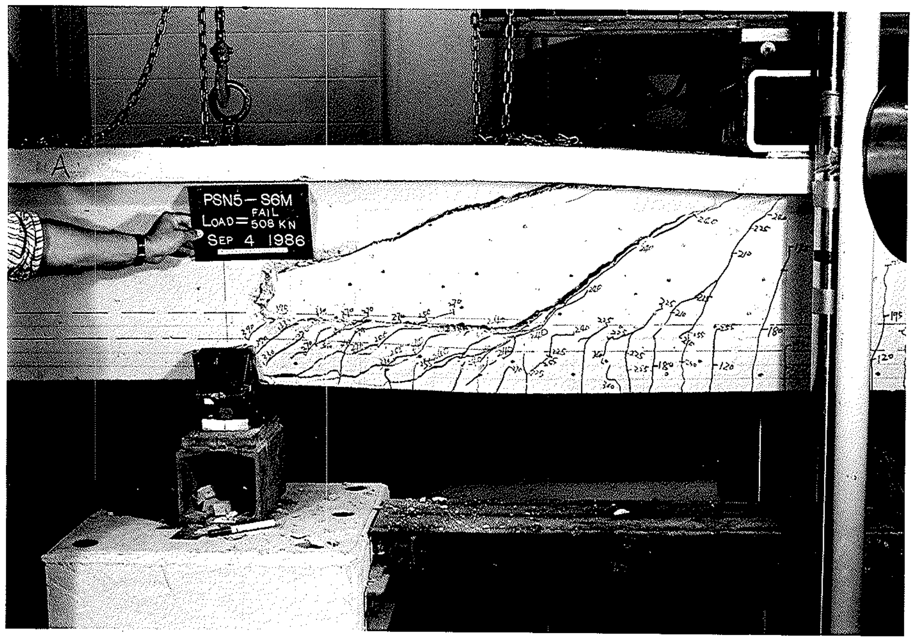


Figure 4.1-PSN5 Crack Pattern of Beam PSN5-S6M

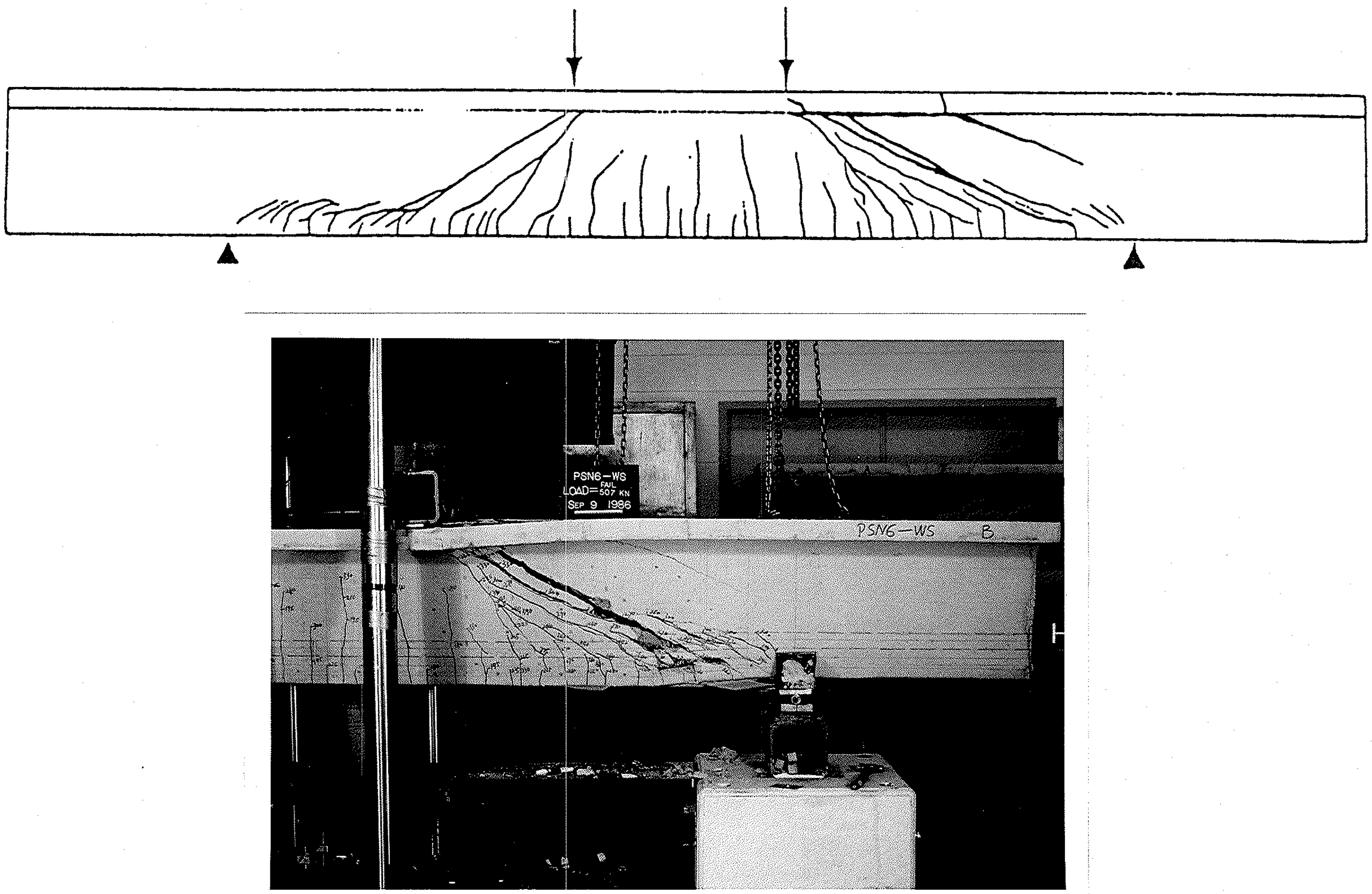


Figure 4.1-PSN6 Crack Pattern of Beam PSN6-WS

Figure 4.2-PSN2 Failure Crack of Beam PSN2-WD

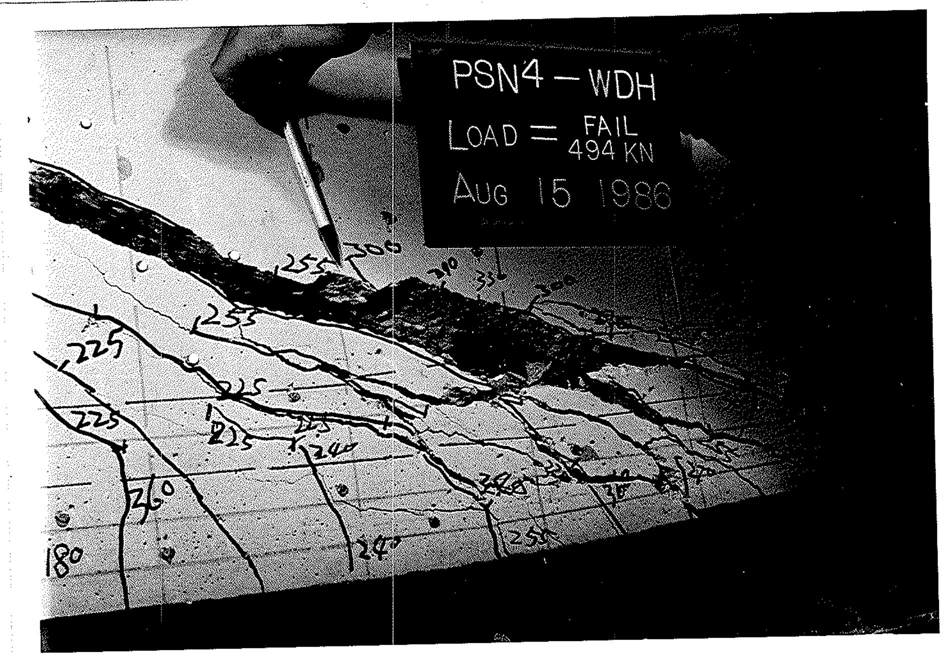


Figure 4.2-PSN4 Failure Crack of Beam PSN4-WDH

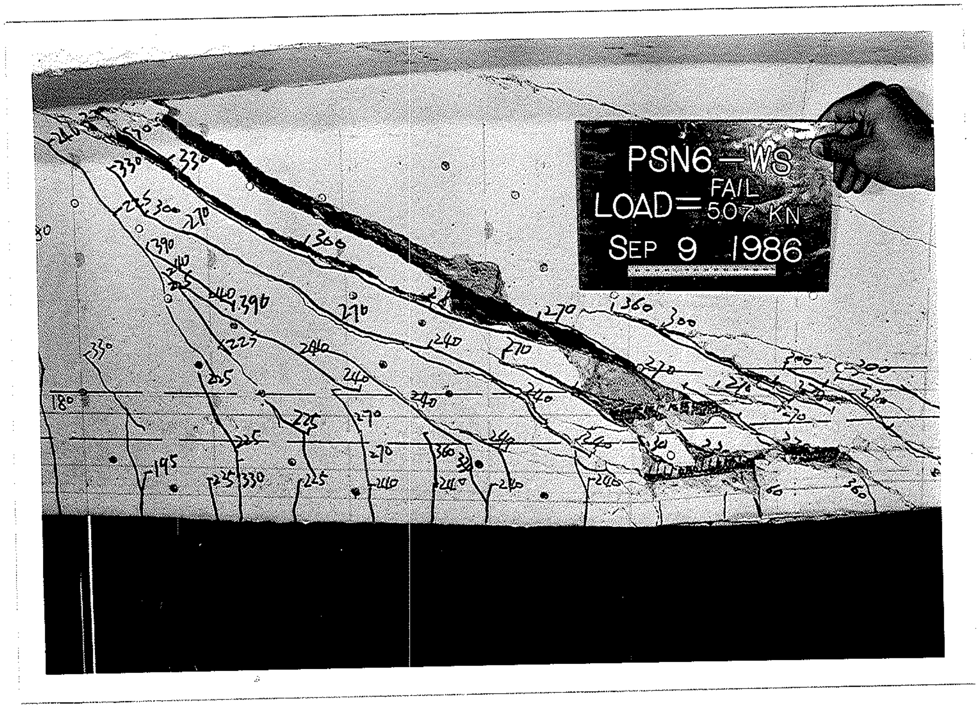


Figure 4.2-PSN6 Failure Crack of Beam PSN6-WS

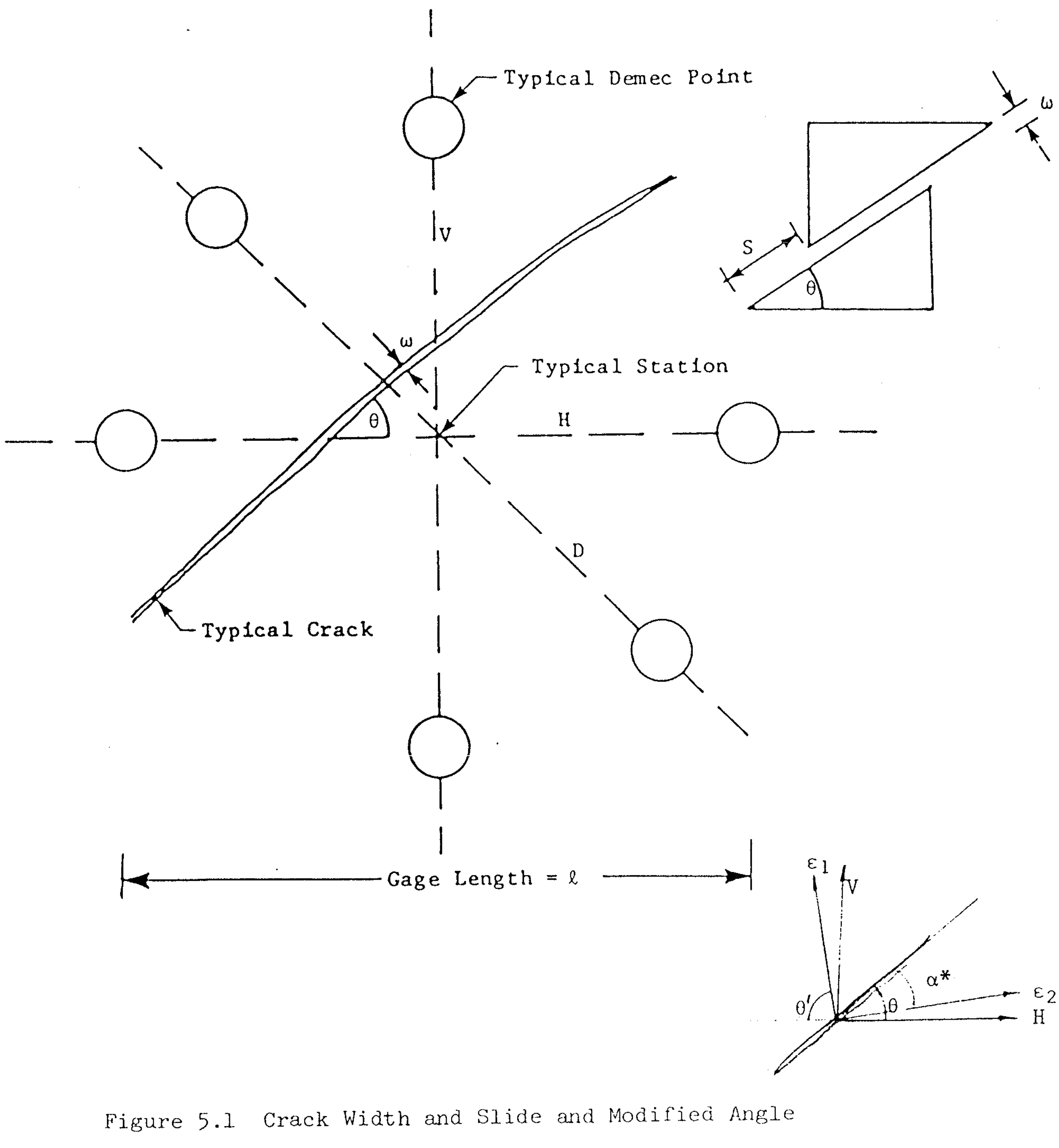


Figure 5.1 Crack Width and Slide and Modified Angle

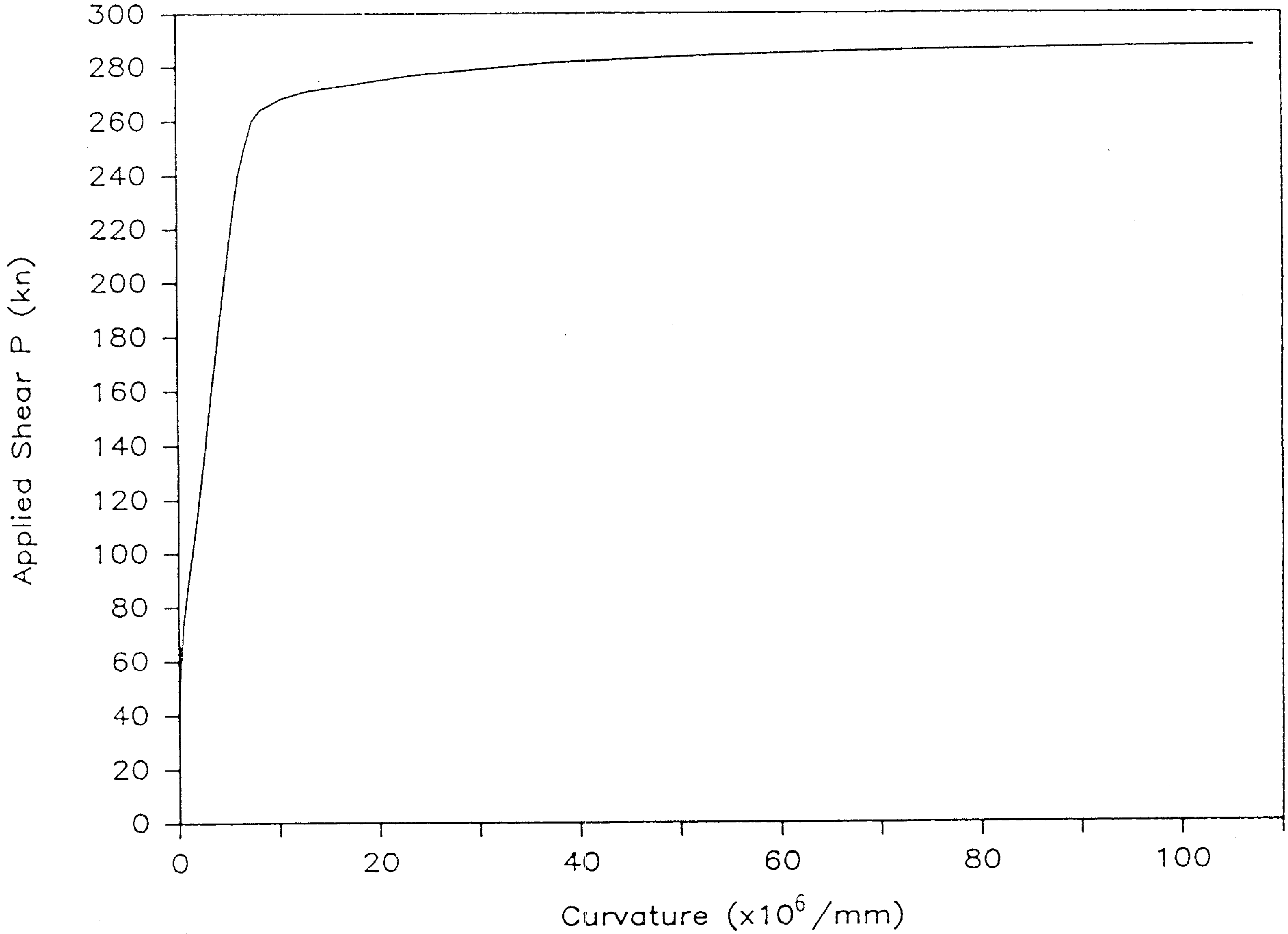


Figure 5.2 Calculated Load-curvature Curve of Specimens

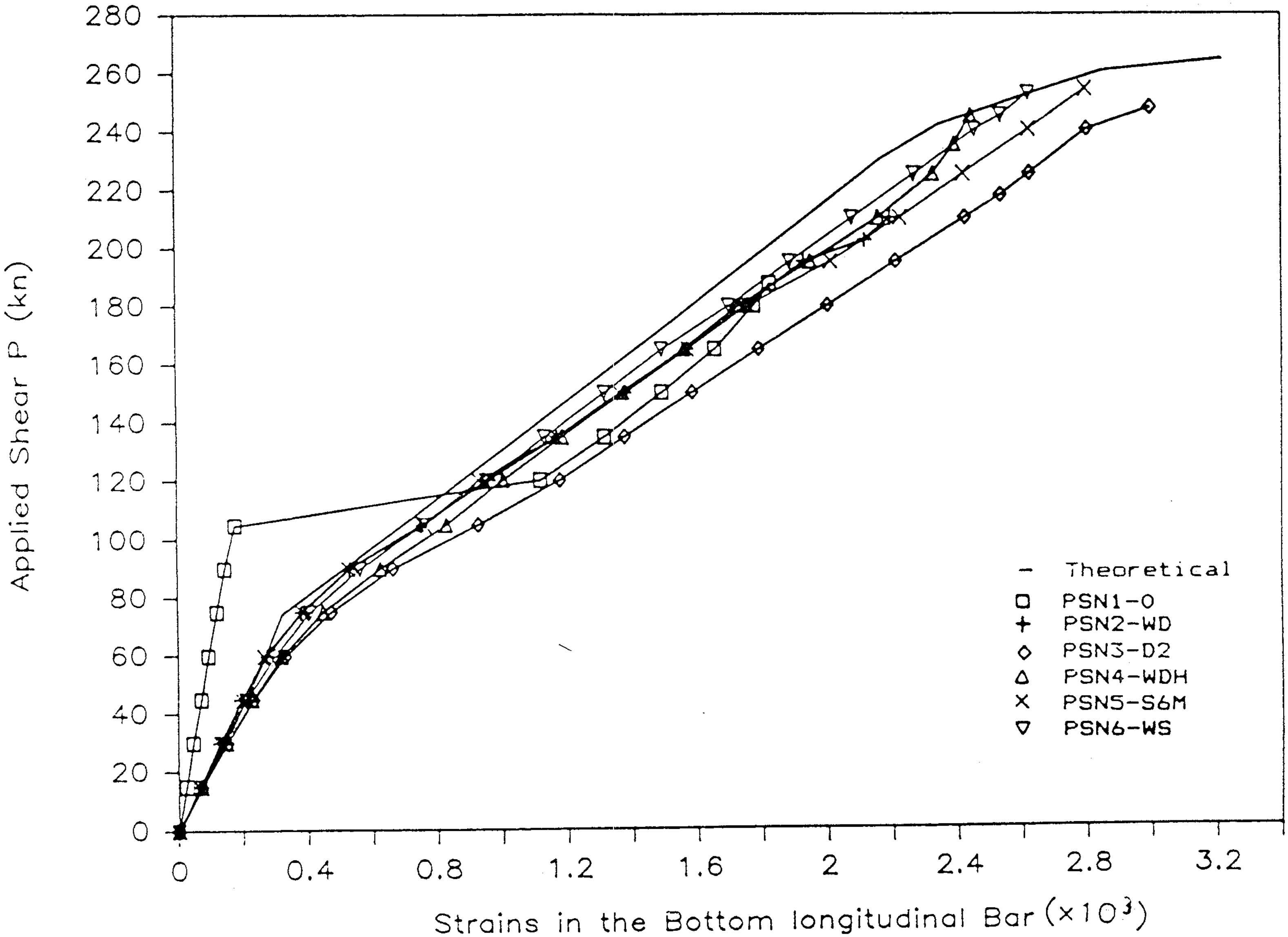


Figure 5.3 Steel Strain in the Bottom Longitudinal Bars

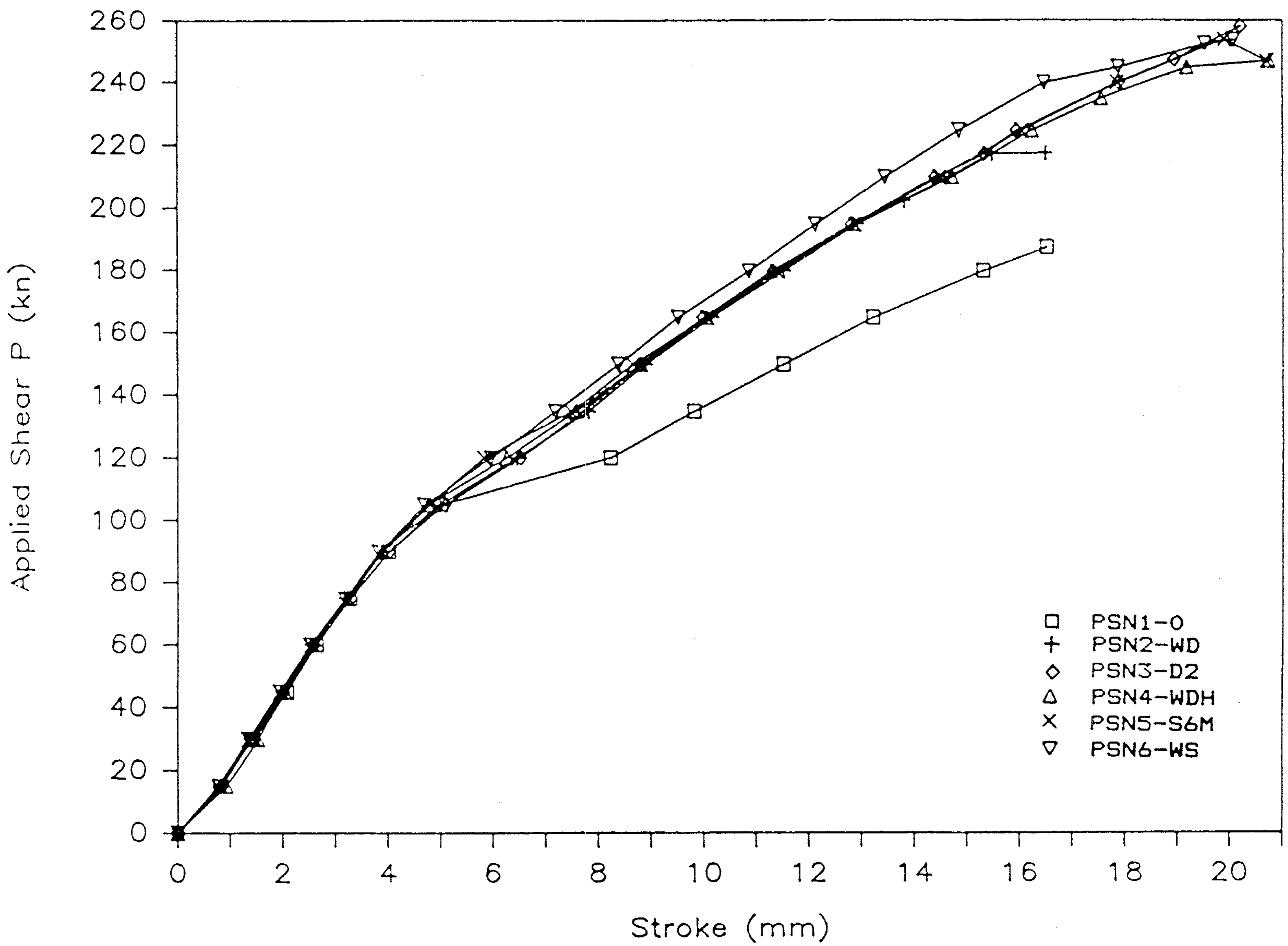


Figure 5.4 Load-stroke Curve of Specimens

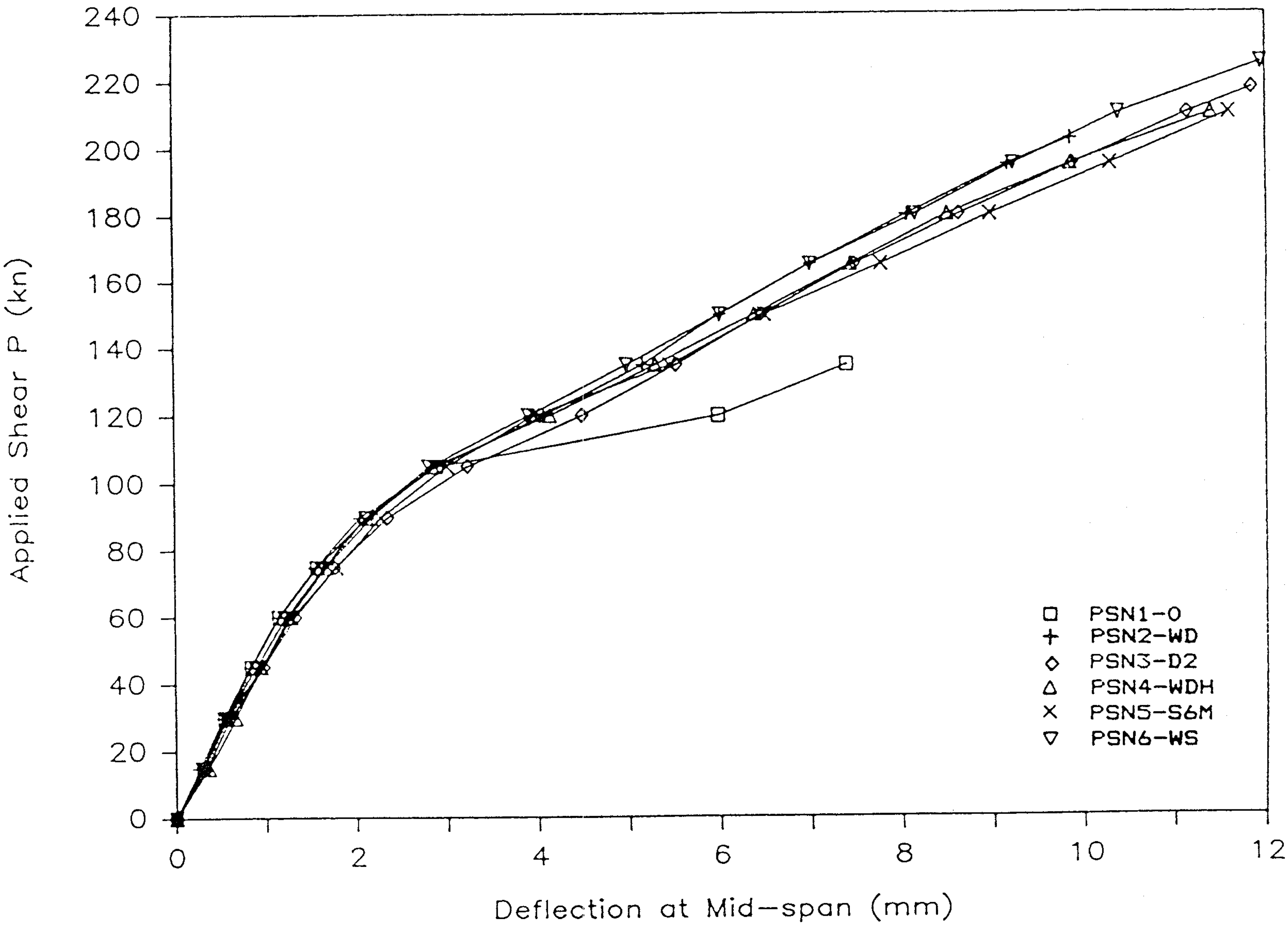


Figure 5.5 Load-deflection at Mid-span

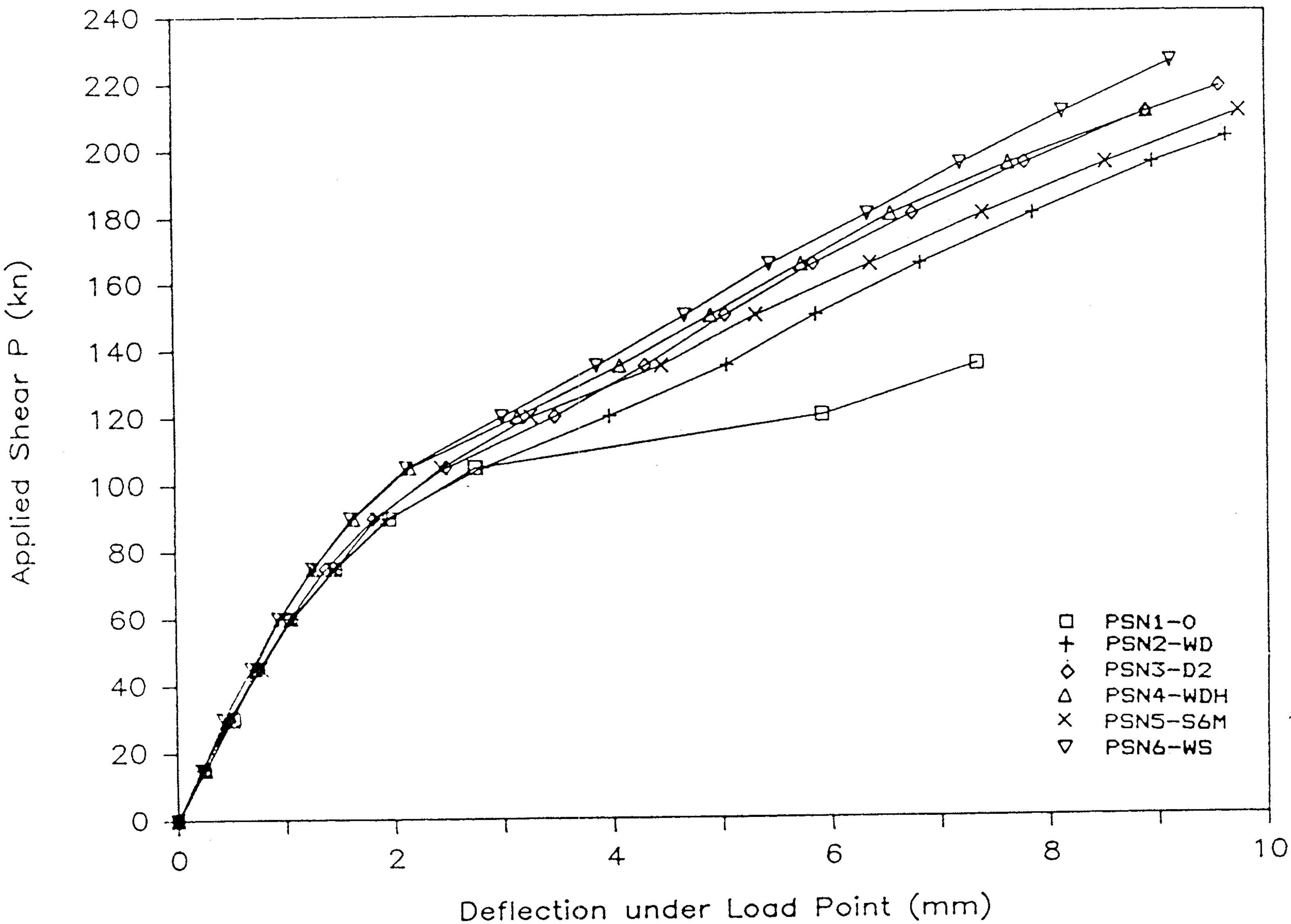


Figure 5.6 Load-deflection under Load Point at Failure Span

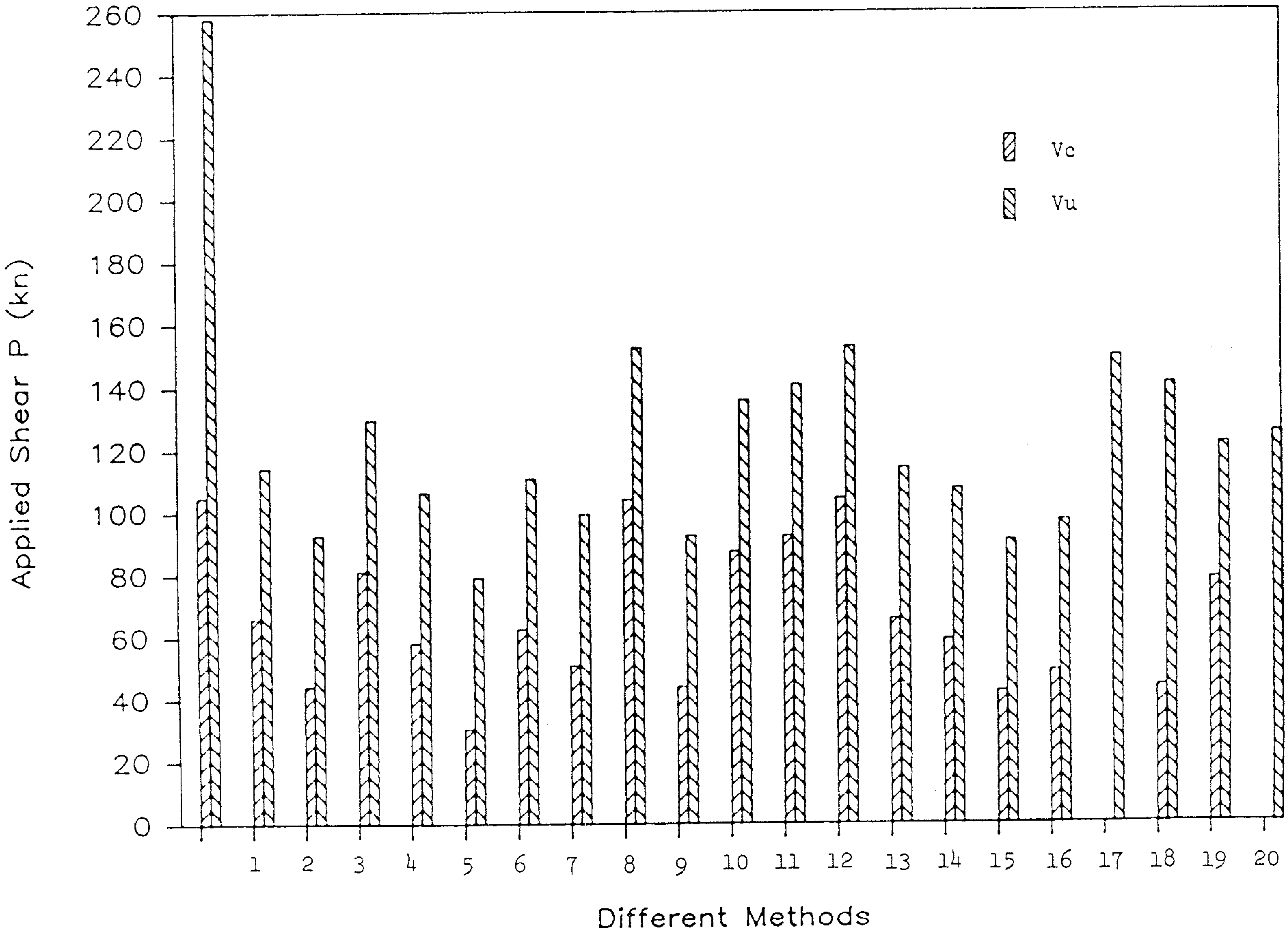


Figure 5.7 Predicted Shear Strengths for Beam PSN3-D2 Using 20 Different Methods

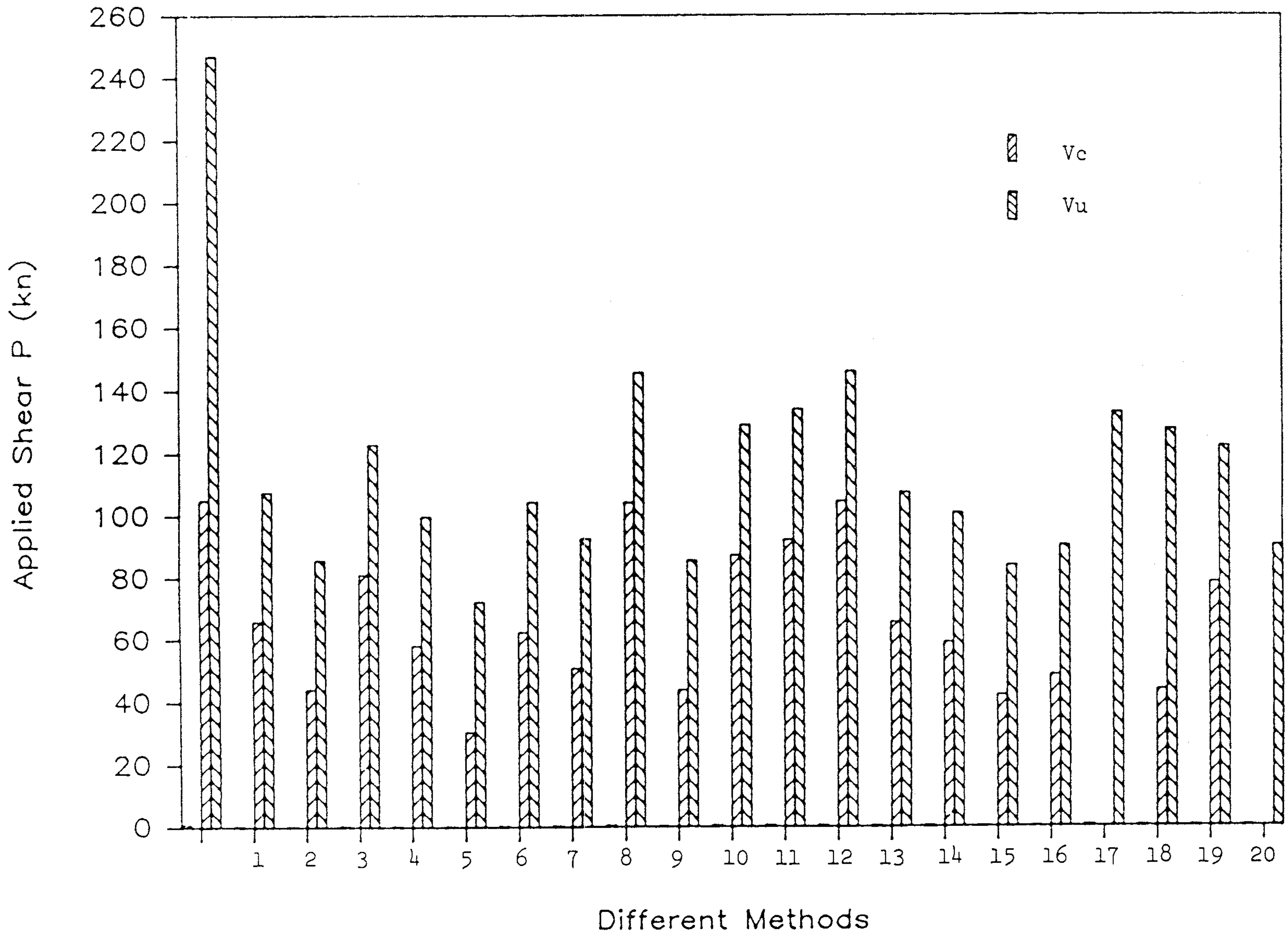


Figure 5.8 Predicted Shear Strengths for Beam PSN4-WDH Using 20 Different Methods

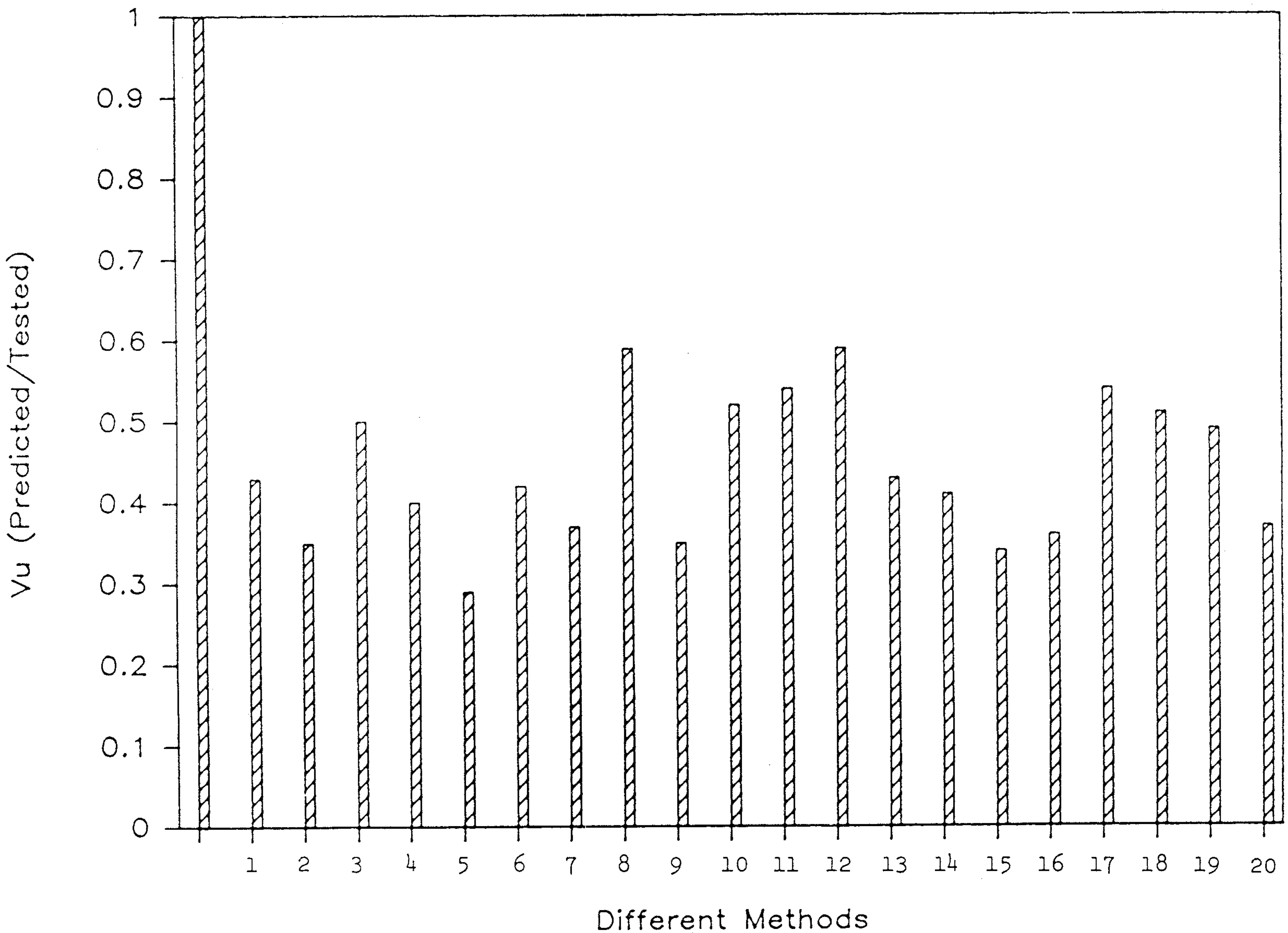


Figure 5.9 Vu (Predicted/Tested) for Beam PSN4-WDH Using 20 Different Methods

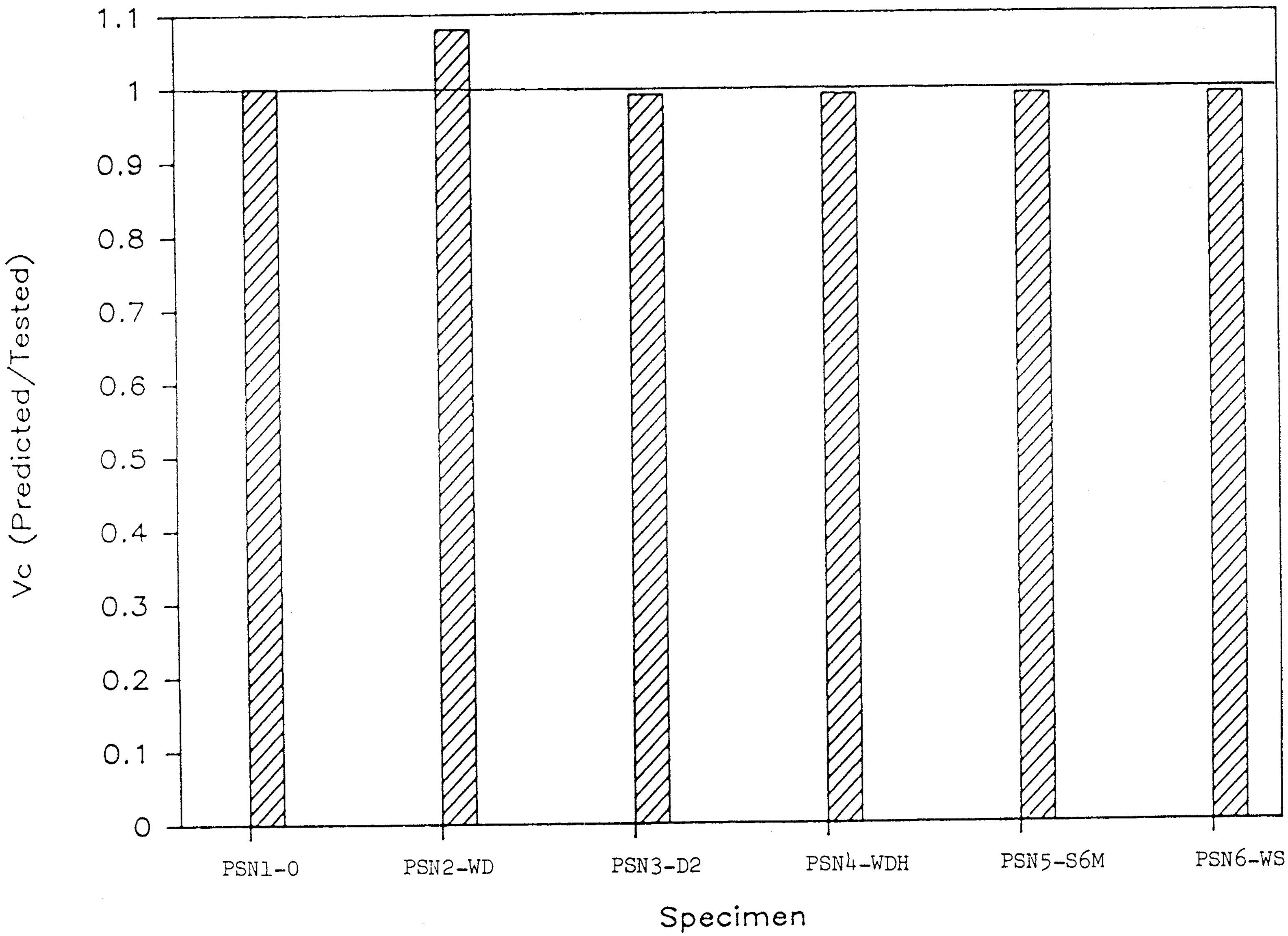


Figure 5.10 Beam Strength Vc(ACI Predicted/tested)

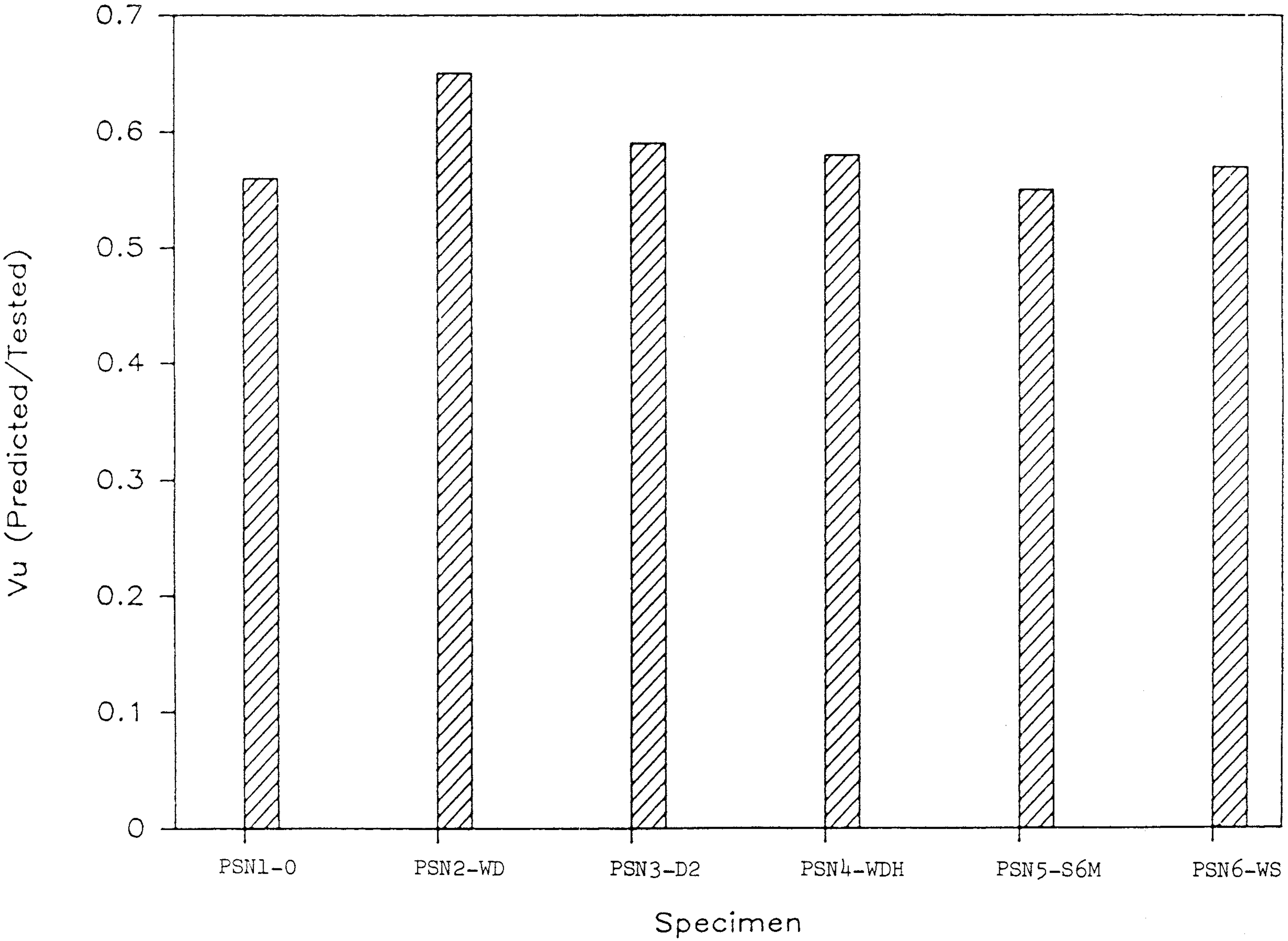


Figure 5.11 Beam Strength Vu(ACI Predicted/Tested)

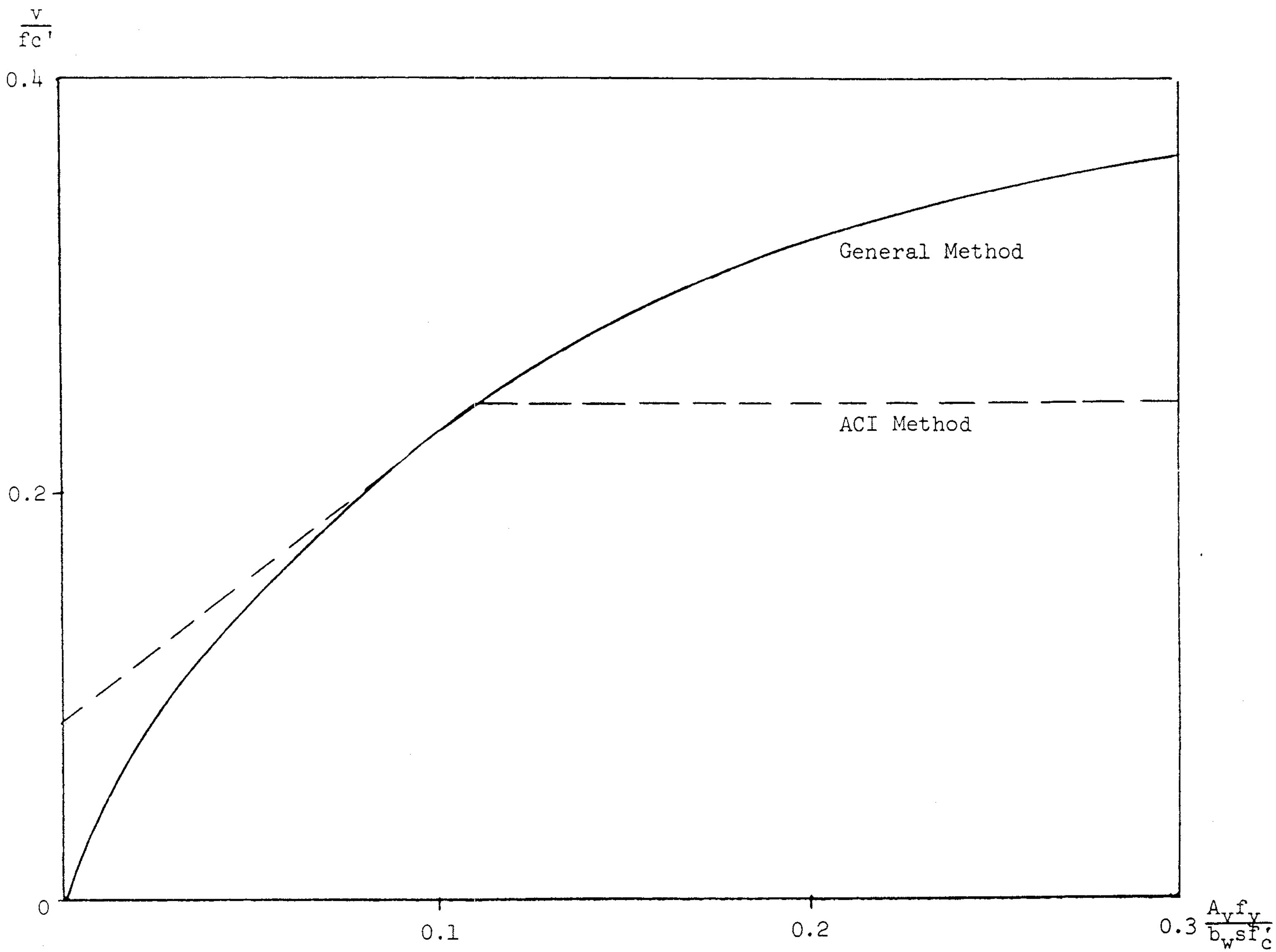


Figure 5.12 Relationship between Amounts of Shear Reinforcement and Shear Strength Predicted by General Method and ACI Code

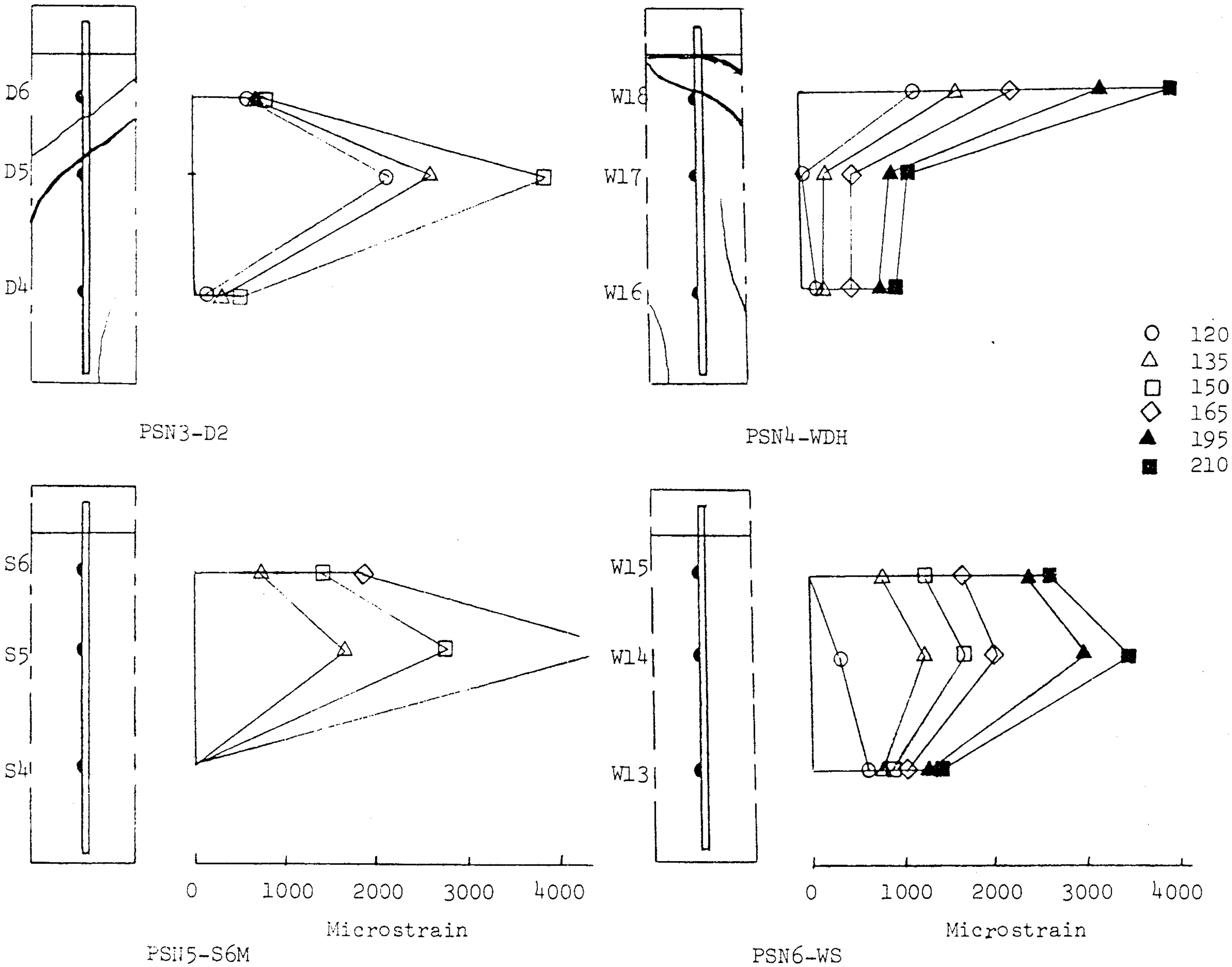


Figure 5.13 Typical Strain Distribution in Stirrups

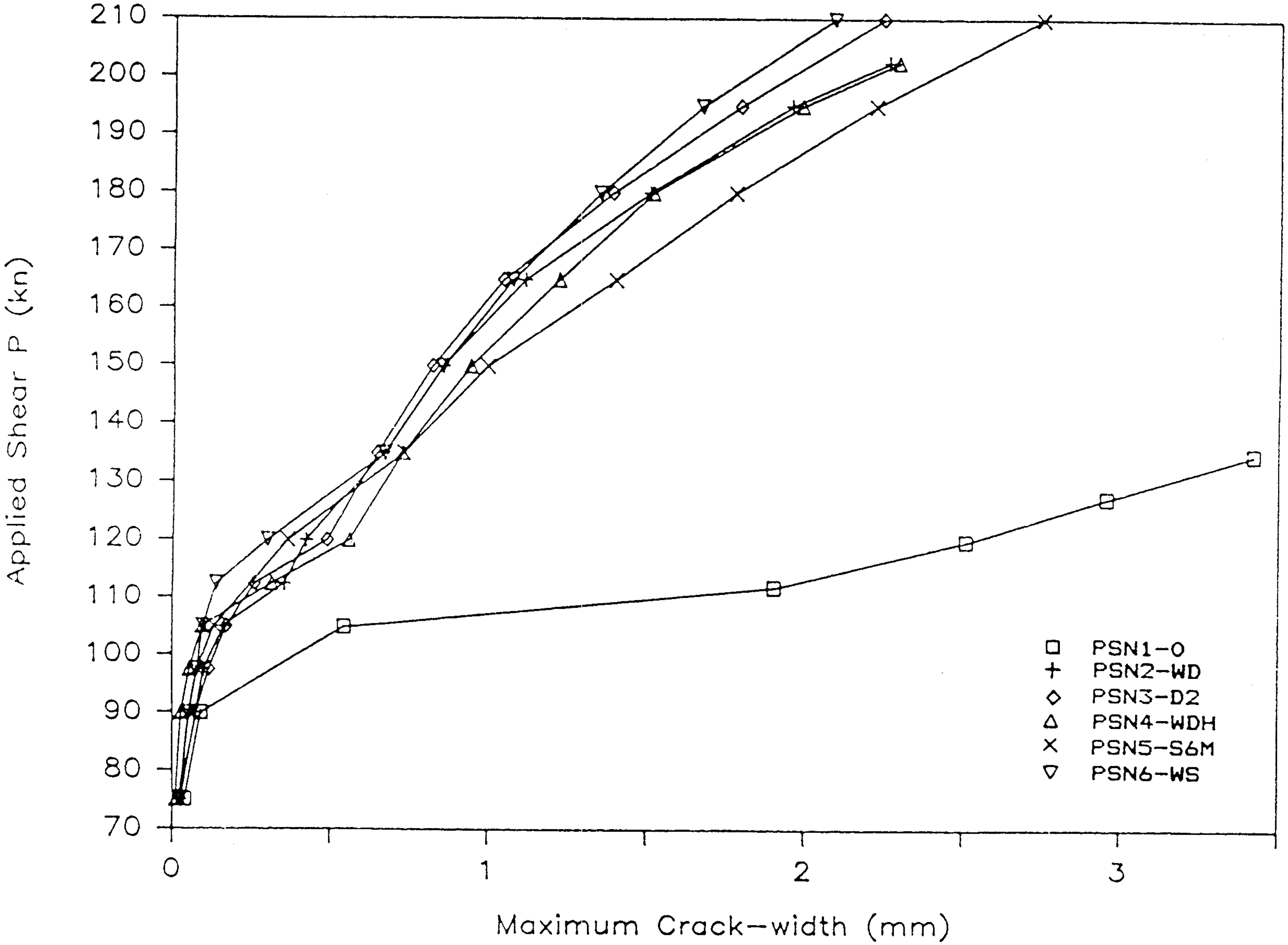


Figure 5.14 Applied Shear-Maximum Crack Width Curve

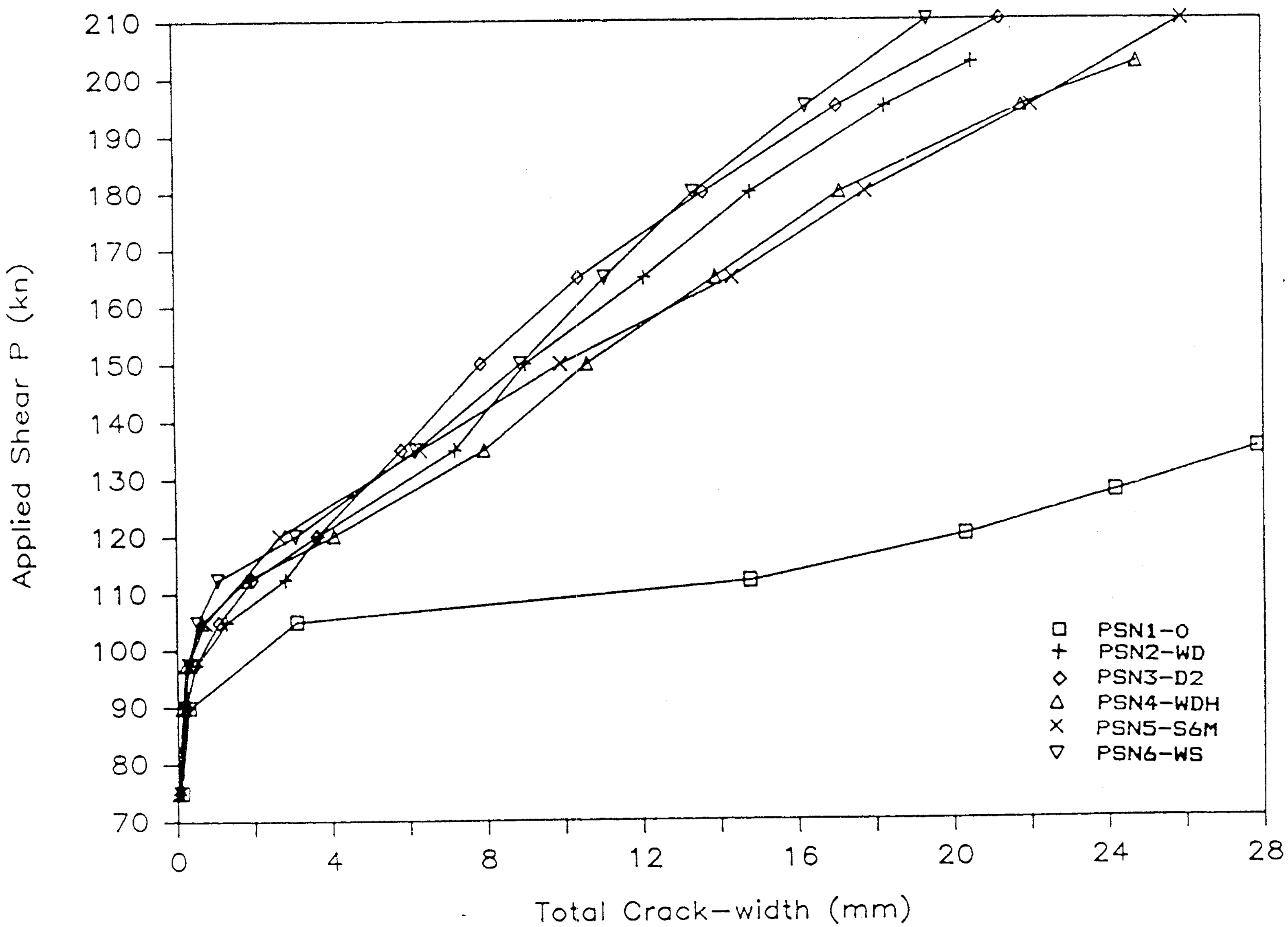


Figure 5.15 Applied Shear-Total Crack Width Curve