APPENDIX F

I-BEAM SUMMARIES—0.5-IN. STRAND

BEAM NAME: IB-6-5-1
END: ***NORTH***
DATE: 09/02/2005

TEST PARAMETERS	
Concrete Compressive Strength	**9350 psi.**
Embedment Length(L_e)	**58 in.**
Span	**166 in.**
Failure Mode	**Shear**
Maximum Load	**117.4 kips**
Maximum Shear	**74.4 kips**
Maximum Moment	**3870 kip-in**
Maximum Deflection attained	**1.1 in.**
Rebound after complete unloading	**0.6 in.**
Average NASP P.O value for strand "B"	**20.21 kips**

	Transfer lengths (in.) for beam # IB-6-5-1		
		At Release	At the time of testing
North	Top	21.43	35.9
	Middle	16	22.63
	Bottom East	16.12	21.23
	Bottom Central	10.93	14.3
	Bottom West	17.82	23.76

TEST SUMMARY

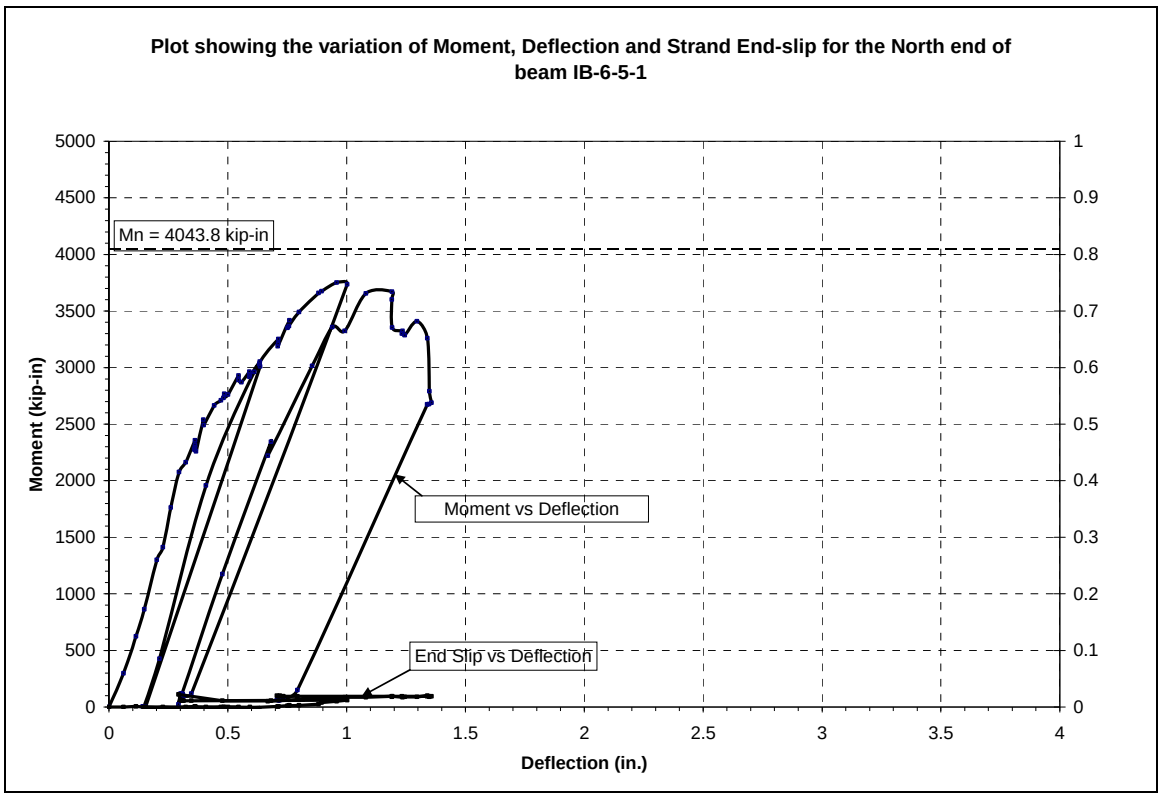
The beam was loaded in multiple cycles. For the first loading cycle, initial load increments were set at 3.0 kips till the first flexural cracking was observed. Beyond first cracking, loading was added as deflections increased in increments of 0.020 in. For the 2nd and following loading cycles, the deflection increments were set to 0.10 in. DEMEC readings were taken during each increment.

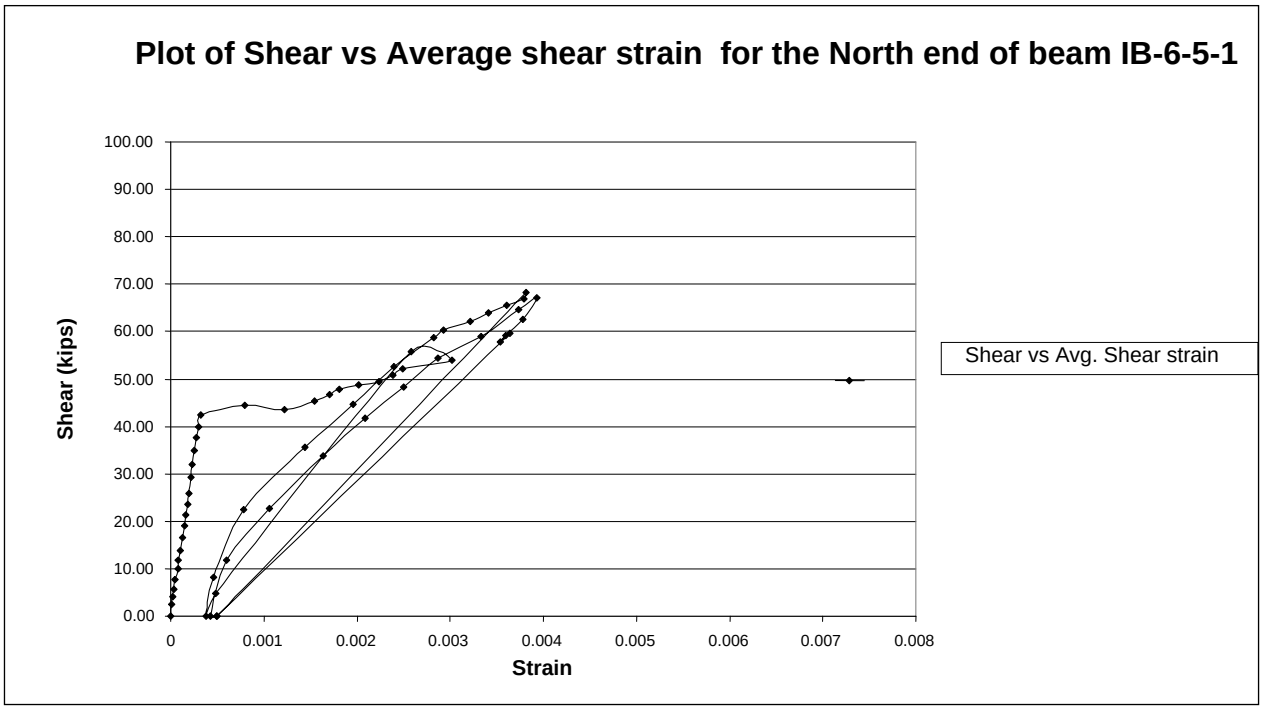
First flexural cracking was observed at the load of 69.1 kips (Shear =43.8 k; Δ = 0.34 in.). First flexural cracks were formed in the form of a pair of cracks located approximately below the two load points. Initial web shear cracks were observed at the load of 76.7 kips (Shear = 48.6 kips; Δ = 0.37 in.). Several web shear cracks formed virtually at the same time and parallel to each other in the shear zone. The first and the last cracks from the North end were longer than those formed in between them. DEMEC readings were taken after the cracks were formed. A secondary flexural crack was noticed at Station 60 at the load of 82.7 kips (Shear = 52.4 kips; Δ = 0.46 in.). More secondary cracks continued to form throughout the loading cycle.

First end slip of 0.01 in was noticed at the load of 101.8 kips (Shear = 64.5 kips; $\Delta = 0.7$ in.)

Cracks were clearly audible during the last loading cycle as the load reached 117.4 kips (Shear = 67.8 kips; $\Delta = 0.9$ in.) and the load dropped to 108.4 kips after the cracks were completely formed. The load value did not reach its maximum after this point, as for every further increment the load increased and dropped back with generation of audible cracks. It was noticed that the diagonal cracks were widening with each deflection increment. At the last load increment, a loud cracking noise was heard which indicated either a strand wire fracture or the stirrup failure at the total deflection of 1.1 in. The test was stopped at this point, in part because the opposite end of this beam was needed for testing. The beam was unloaded and the DEMEC points as well as the deflection and end slip values were noted after complete unloading. The value of end slip at the South end remained 0.00 in. throughout the loading and unloading cycles.

The failure of the beam was determined to be a shear failure as web shear cracks were widening. Also, the measured load vs. deflection curve generally conforms to that of a shear failure, and nominal flexural capacity was not achieved. The loud noises are believed to be stirrup or strand wire ruptures though no excavation of the failed beam was performed to confirm this conclusion.





(In all the photographs presented below, cracks marked in black represent the ones originated as flexural cracks while those marked in blue represent the web shear cracks. Red color was used only for marking the grid lines and station points. Number written in red should not be confused with the load values.)

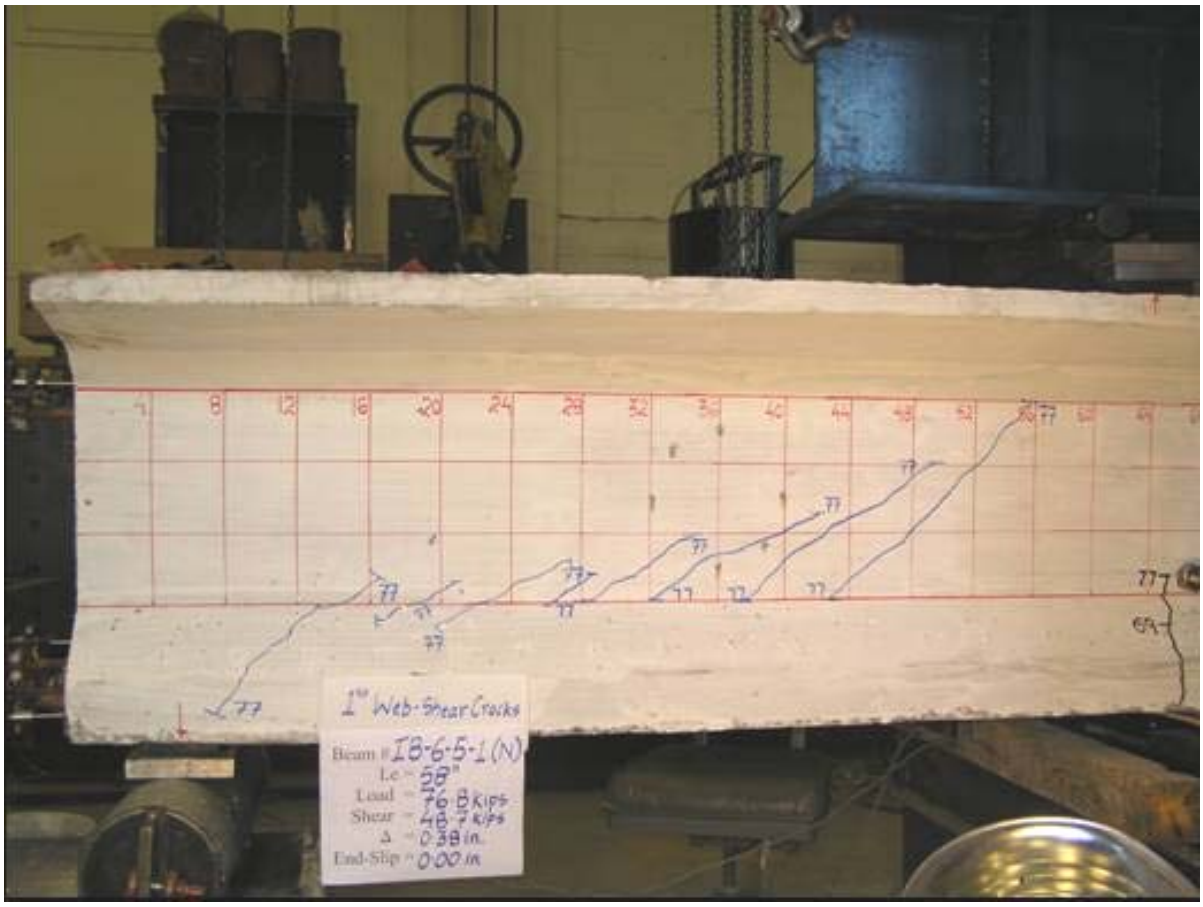


Photo of the North end of the beam IB-6-5-1 showing the first web shear cracking

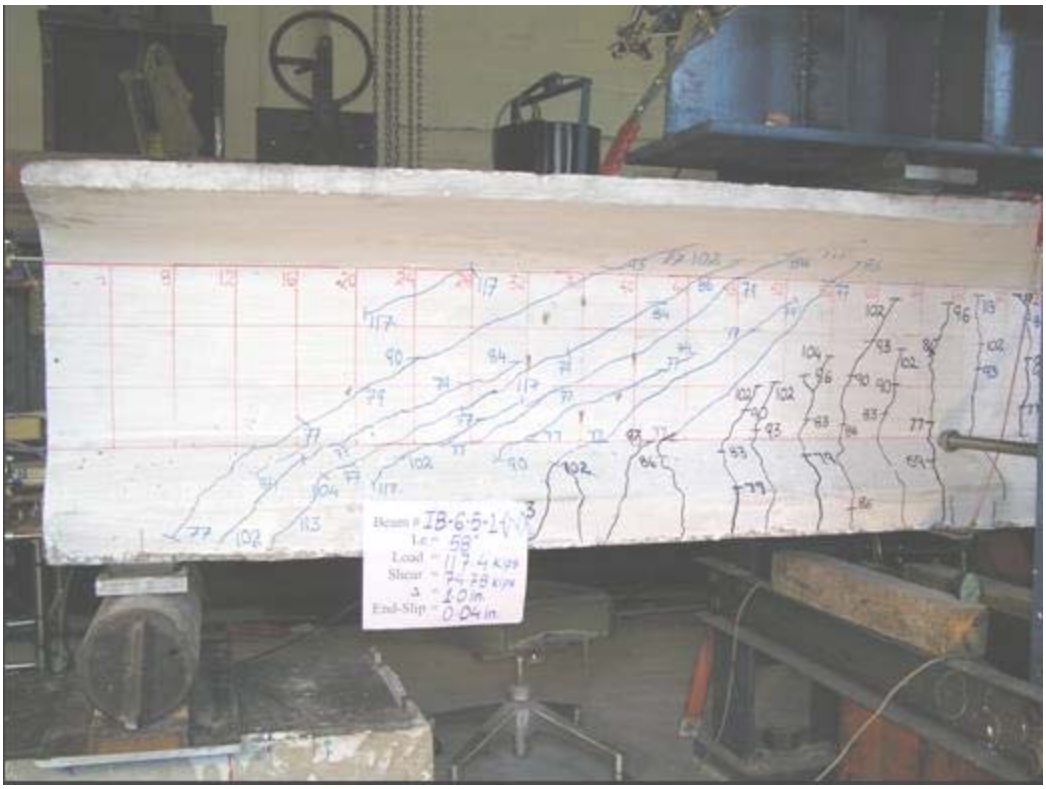


Photo of North end of beam IB-6-5-1 showing the cracking pattern at the maximum load

BEAM NAME: IB-6-5-1
END: ***SOUTH***
DATE: 08/31/2005

TEST PARAMETERS	
Concrete Compressive Strength	**9350 psi**
Embedment Length(L_e)	**72 in.**
Span	**222 in.**
Failure Mode	**Flexure**
Maximum Load	**90.4 kips**
Maximum Shear	**60.3 kips**
Maximum Moment	**3979.8 kip-in.**
Maximum Deflection attained	**3.1 in.**
Rebound after complete unloading	**Beam failed without rebound**
Average NASP P.O value for strand "B"	**20.21 kips**

	Transfer lengths (in.) for beam # IB-6-5-1		
		At Release	At the time of testing
South	Top	6.16	23.04
	Middle	6.48	14.35
	Bottom East	6.42	13.11
	Bottom Central	9.45	16.19
	Bottom West	2.90	3.69

TEST SUMMARY

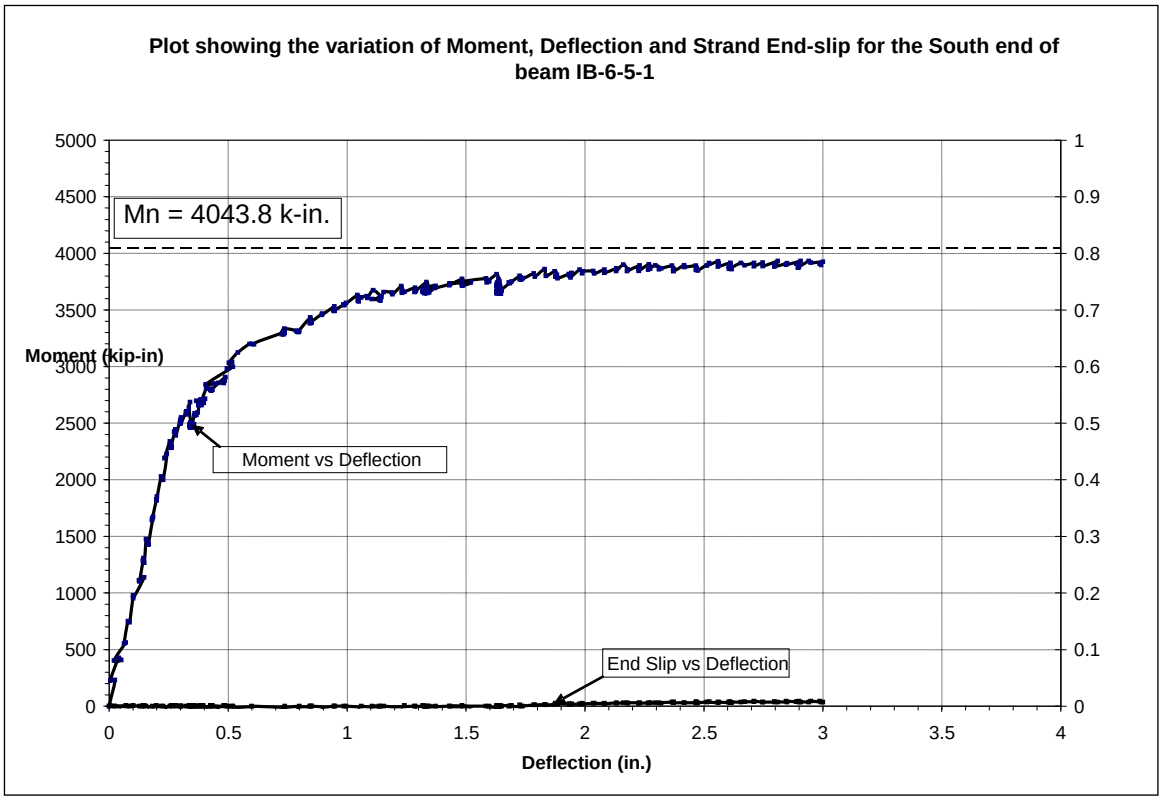
Load was applied in approximate 4.0 k increments until first flexural cracking was observed. After cracking, the beam was loaded to deflection increments of 0.025 in. until the total deflection reached 0.4 in. Further increments of deflection were 0.05 in. per load increment. DEMEC readings were taken at all load increments at both faces (East and West) with the rectangular rosette pattern at 36 in from the end being tested.

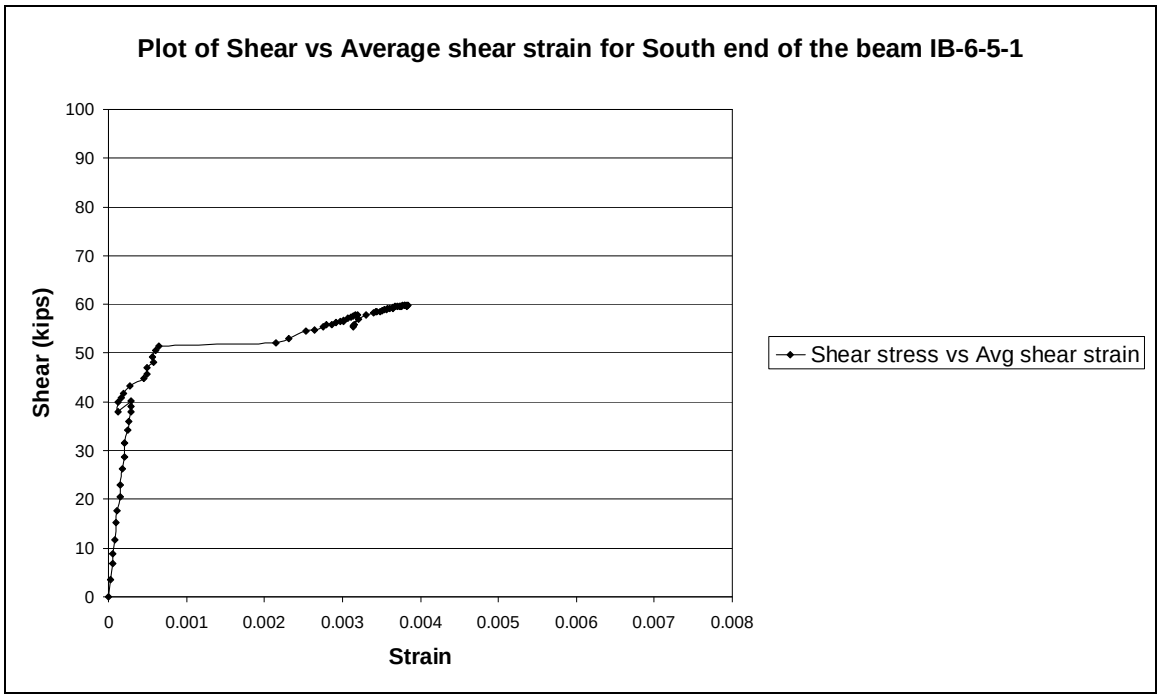
First flexural cracking was observed at the load of 54.1 kips (Shear = 36 kips; Δ = 0.26 in.) The first flexural crack was observed approximately at the mid span region approximately equidistant from the two point loads. At the load of 61.2 kips (Shear = 40.8 kips; Δ = 0.34 in.), while marking the new flexural cracks formed at that load, first web shear cracking occurred suddenly. The first web shear cracks were observed as a number of cracks approximately parallel to each other and inclined diagonally with two of the innermost cracks longer than the rest. The load dropped to a value of 56.9 kips. DEMEC readings were taken at the reduced value of load.

At 64.8 kips (Shear = 43.2 kips; Δ = 0.45 in) first secondary crack was noticed between Station 92 and Station 96. More secondary cracks continued to form as the load increased

further. Web shear cracks became audible beyond the load of 70.4 kips (Shear = 46.9 kips; Δ = 0.6 in.)

First end slip of 0.01 in. was noted at the load of 85.2 kips (Shear = 56.8 kips; Δ = 1.4 in.). The end slip value remained at 0.01 in. until failure occurred. At failure end slips suddenly increased to 0.025 in. Failure was distinguished by a concrete crushing failure of the compression flange. Crushing failure was accompanied by a large sound at the load of 90.4 kips (Shear = 60.3 kips; deflection = 3.1 in.)





(In all the photographs presented below, cracks marked in black represent the ones originated as flexural cracks while those marked in blue represent the web shear cracks. Red color was used only for marking the grid lines and station points. Number written in red should not be confused with the load values.)

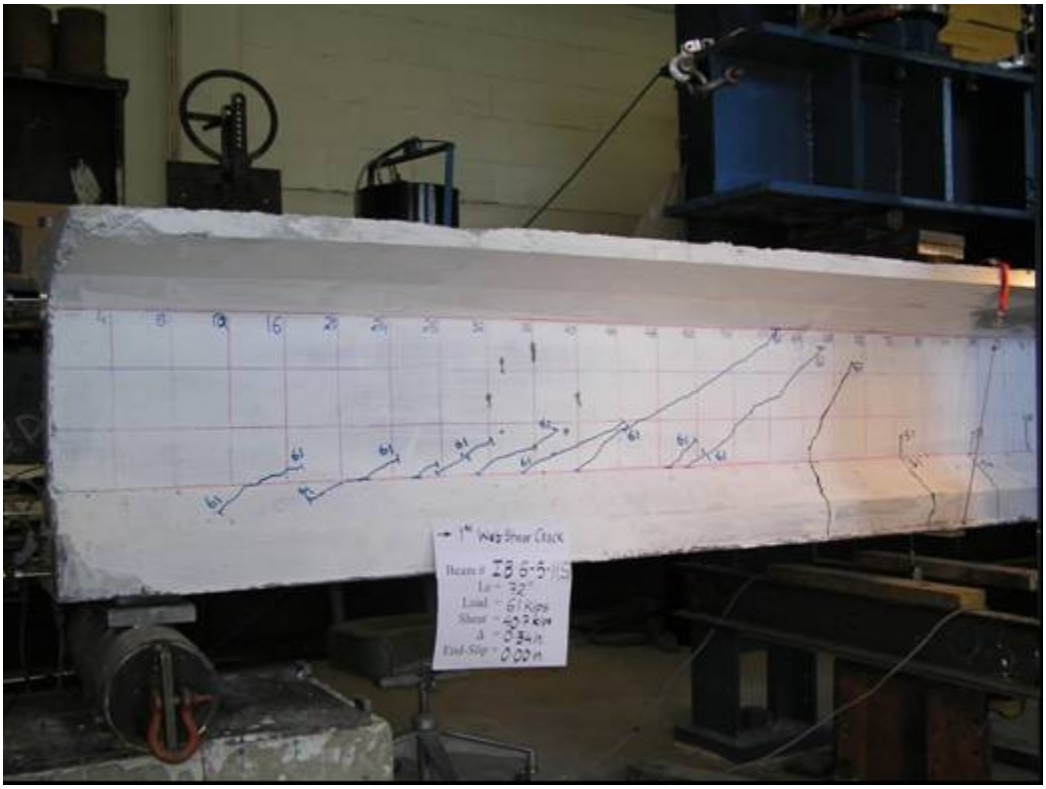


Photo of the South end of the beam IB-6-5-1 showing the first web shear cracking

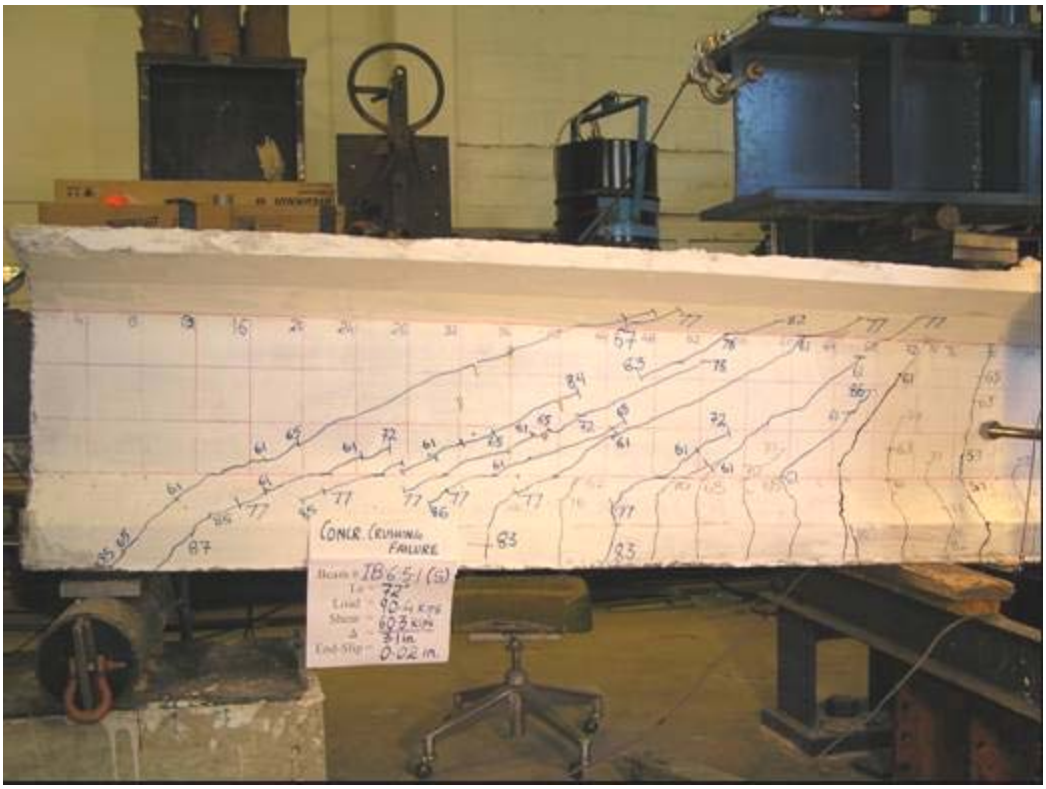


Photo of South end of beam IB-6-5-1 showing the cracking pattern at concrete crushing failure

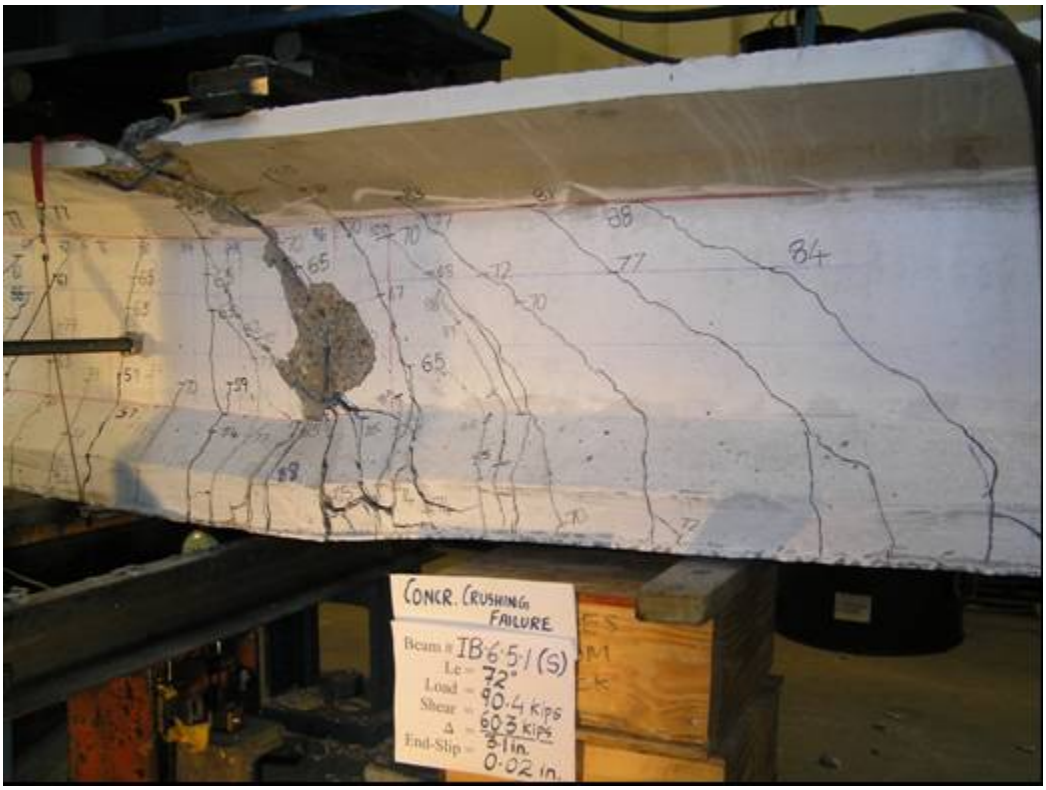


Photo of the crushed region of beam IB-6-5-1 (South end test)

BEAM NAME: IB-10-5-1
END: ***NORTH***
DATE: 09/15/2005

TEST PARAMETERS	
Concrete Compressive Strength	**13490 psi**
Embedment Length(L_e)	**54 in.**
Span	**168 in.**
Failure Mode	**Flexure**
Maximum Load	**133.8 kips**
Maximum Shear	**89.2 kips**
Maximum Moment	**4281.6 kip-in**
Maximum Deflection attained	**2.0 in.**
Rebound after complete unloading	**1.0 in.**
Average NASP P.O value for strand "B"	**20.21 kips**

	Transfer lengths (in.) for beam # IB-10-5-1		
		At Release	At the time of testing
North	Top	-	23.31
	Middle	11.31	15.73
	Bottom East	11.14	15.73
	Bottom Central	11.60	24.02
	Bottom West	10.03	19.54

TEST SUMMARY

Load was applied in approximately 6.0 kips increments until first flexural cracking. Beyond this point, loads were increased at deflection increments of 0.025 in. until total deflection reached 1.30 in. Beyond 1.3 in., further deflection increments were 0.05 in. DEMEC readings were taken at all load increments at both faces (East and West) with the rectangular rosette pattern at 36 in from the end being tested.

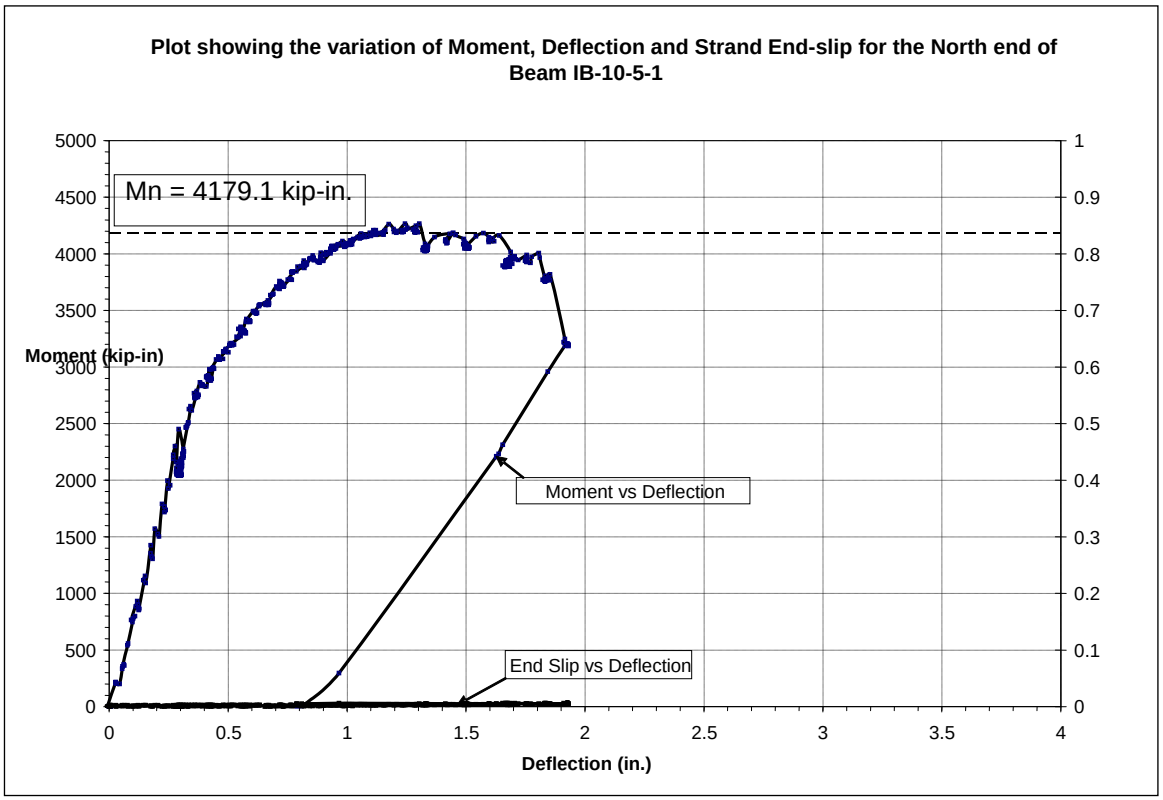
First flexural cracks occurred simultaneously with the first web shear cracks at the load of 77.2 kips (Shear = 51.5 kips) and deflection of 0.3 in. First flexural cracks occurred in a pair of cracks located approximately below the two load points. First web shear cracks occurred in the form of a number of cracks almost parallel to each other in the shear zone.

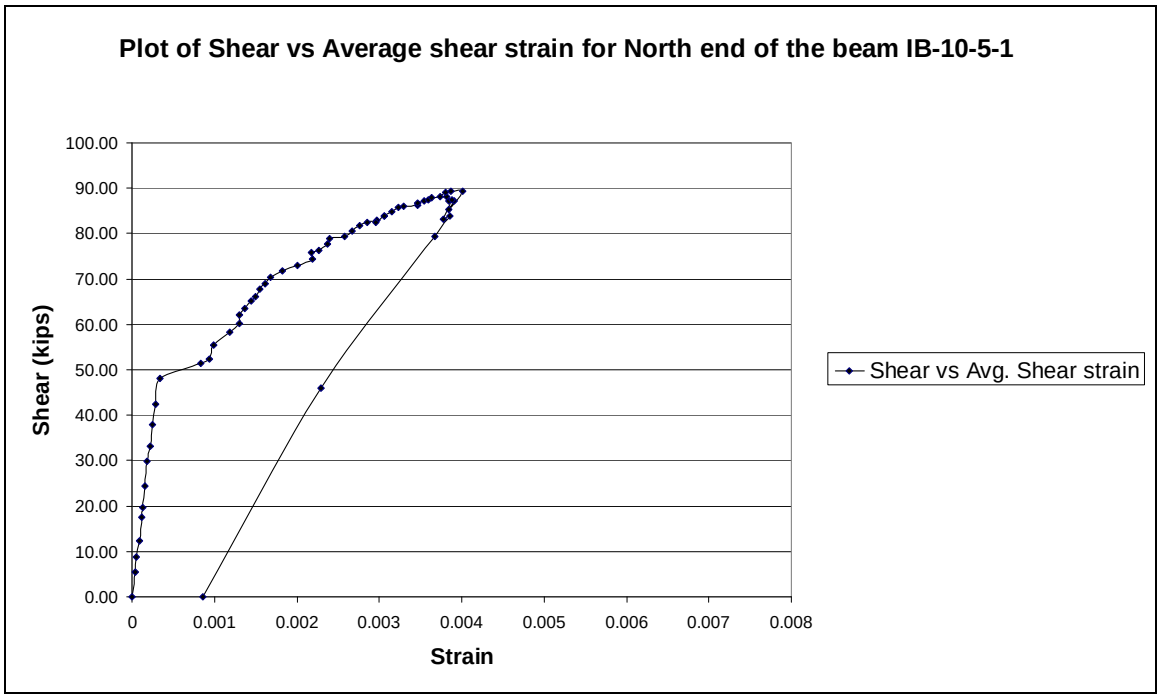
At the load of 90.4 kips (Shear = 60.3 kips) and deflection of 0.4 in. secondary flexural cracks were observed located at Station 64, 68 and 44 in. More and more secondary cracks occurred at further loadings along with occurrences of new flexural cracks.

All the cracks including first web-shear and first flexural cracks were clearly audible. Cracking sounds became prolonged after the load of 119.1 kips (Shear = 79.4 kips; Δ = 0.9 in.)

An inclined flexural crack was observed simultaneously with a loud sound near the South support at the load of 123.6 kips (Shear = 82.4 kips ; deflection = 1.0 in.). Values of load continued to increase with every increment up to the load of 133.8 kips (Shear = 89.2 kips ; Δ = 1.4 in.) when the load dropped suddenly with loud noise to 128.0 kips. Further loading increments resulted in recurring rise and fall of load values, every time with loud sounds. Loading was discontinued at the total deflection of 2.0 in. The beam did not reach flexural failure as neither concrete crushing nor strand rupture was observed. However, because the load achieved the nominal flexural capacity and displayed ductility, the failure is determined to be a flexural failure. Additionally, an inclined flexural crack towards the south (opposite) end of the beam had grown wide and would have been the probable location of failure. Web-shear cracks were wide and suggest a possible shear failure of the beam. Loading was discontinued in part to save the beam for a test on the opposite end of the beam.

End-slip readings stayed fairly at 0.00 in. until the load of 113.6 kips (Shear = 75.7 kips ; Δ = 0.8 in.) when the first end-slip of 0.01 in. was noticed. The end-slip reading went on increasing very gradually till the end of the test. Maximum end-slip noted was 0.03 in.)





(In all the photographs presented below, cracks marked in black represent the ones originated as flexural cracks while those marked in blue represent the web shear cracks. Red color was used only for marking the grid lines and station points. Numbers written in red should not be confused with the load values.)

Photo of the North end of the beam IB-10-5-1 showing the first web shear cracking incidentally the point of first flexural cracking as well)

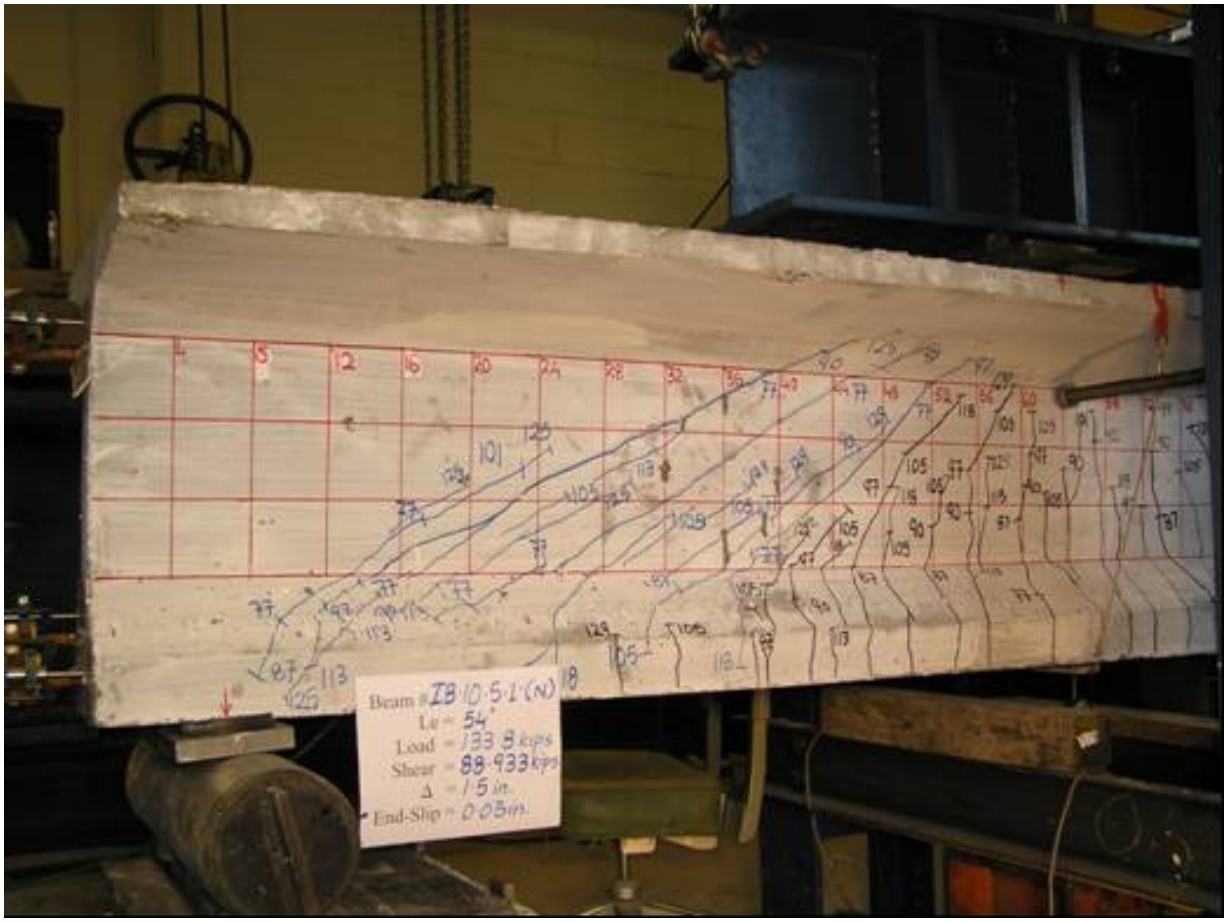


Photo of North end of beam IB-10-5-1 showing the cracking pattern at the maximum load

BEAM NAME: IB-10-5-1
END: SOUTH
DATE: 09/13/2005

TEST PARAMETERS	
Concrete Compressive Strength	**13490 psi**
Embedment Length(L_e)	**58 in.**
Span	**180 in.**
Failure Mode	**Flexure**
Maximum Load	**121 kips**
Maximum Shear	**80.7 kips**
Maximum Moment	**4196.4 kip-in.**
Maximum Deflection attained	**1.55 in.**
Rebound after complete unloading	**1.2 in.**
Average NASP P.O value for strand "B"	**20.21 kips**

	Transfer lengths (in.) for beam # IB-10-5-1		
		At Release	At the time of testing
South	Top	-	21.7
	Middle	9.9	11.59
	Bottom East	12.45	30.14
	Bottom Central	12.45	10.25
	Bottom West	5.80	14.26

TEST SUMMARY

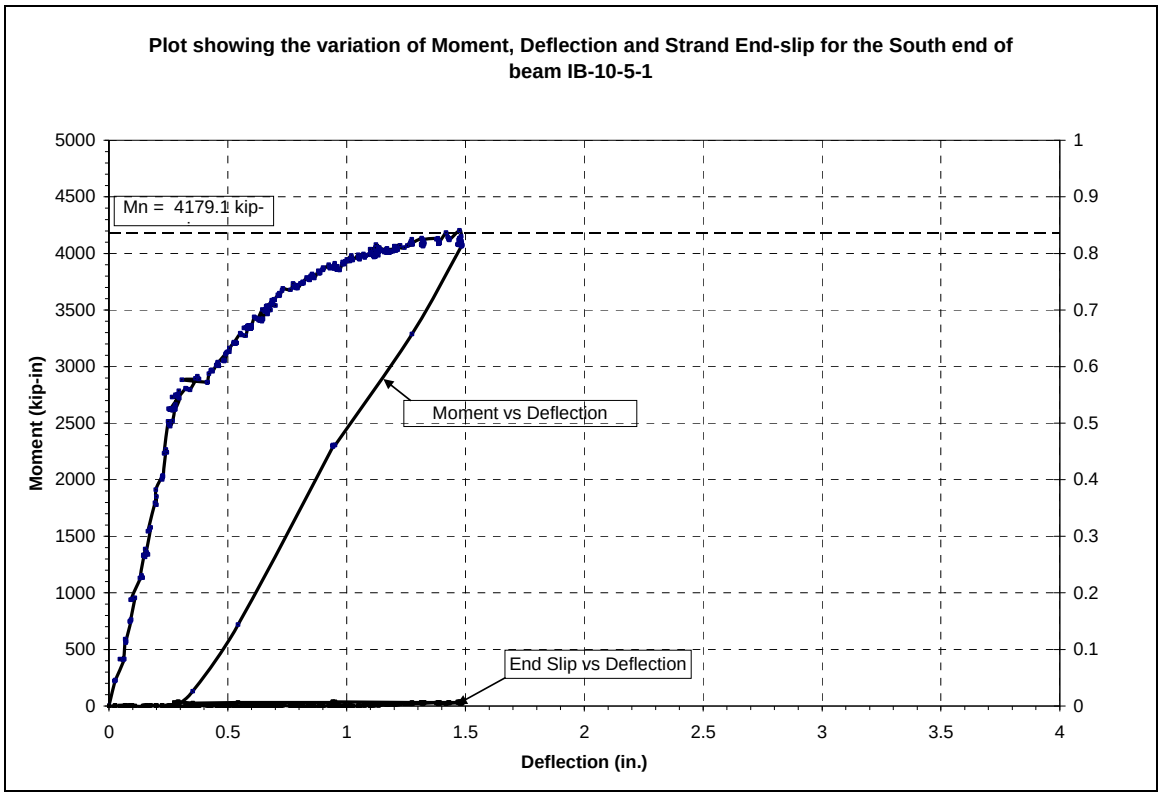
Load was applied in approximate 6.0 k increments until first flexural cracking. Beyond this point the beam was loaded in increments to increase deflection by 0.025 in. After a deflection of 1.30 in. was reached, deflection increments were 0.05 in. until beam failure. DEMEC readings were taken at all load increments at both faces (East and West) with the rectangular rosette pattern at 36 in from the end being tested.

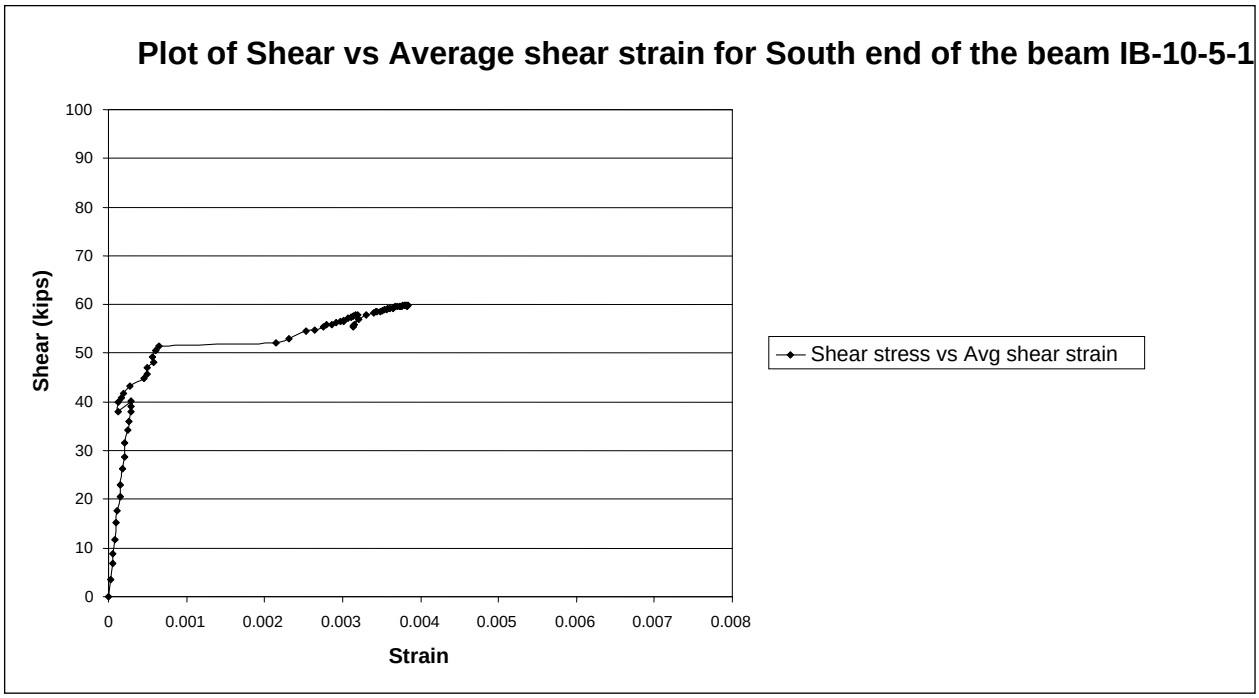
First flexural cracks were observed at 77.5 kips (Shear = 51.7 kips; Δ = 0.33 in.). These cracks occurred in the form of a pair of cracks located approximately below the two point loads. First web shear cracks were observed at the load of 81 kips (Shear = 54 kips; Deflection = 0.38 in.). First web shear cracks occurred in the form of a number of cracks nearly parallel to each other in the shear zone. DEMEC readings were taken after cracking occurred.

Between the first flexural and first web shear cracks a secondary crack was observed at Station 68. More secondary cracks continued to occur throughout the loading cycle. End-slip value remained at 0.00 in till the load reached 118 kips (Shear = 78.7 kips; Δ = 1.3 in.) where the first end-slip of 0.01 in. was noted. The value of end-slip stayed fairly constant at 0.01 in. till the maximum load was attained. With further load increments, the end-slip very gradually rose and the maximum value was 0.02 in.

The applied load was increased with every deflection increment until the applied load reached 121 kips (Shear = 80.7 kips; Δ = 1.55 in.). At this load, the flexural crack near Station 96 had grown considerably wide to suggest strand yielding and a flexural failure. Web shear cracks were not wide enough to suggest a shear failure. Loading was stopped concluding that the beam was failing in flexure.

DEMEC readings were taken at all load increments and after complete unloading. The end-slip value at the North end stayed 0.00 in throughout the loading and unloading cycle.





(In all the photographs presented below, cracks marked in black represent the ones originated as flexural cracks while those marked in blue represent the web shear cracks. Red color was used only for marking the grid lines and station points. Numbers written in red should not be confused with the load values.)

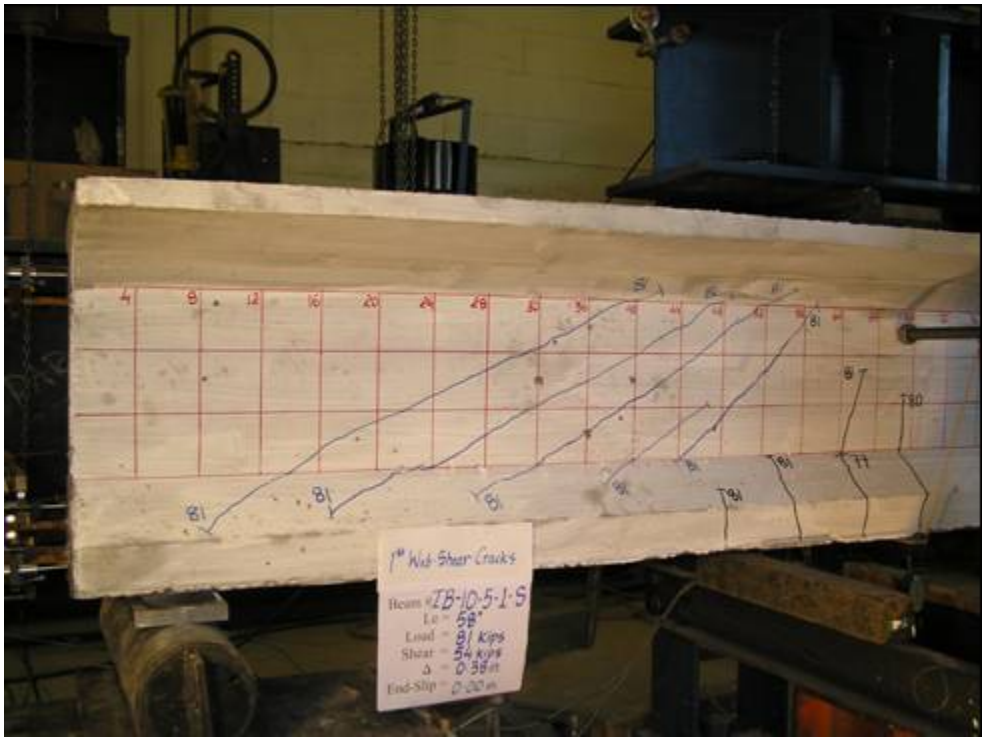


Photo of the South end of the beam IB-10-5-1 showing the first web shear cracking

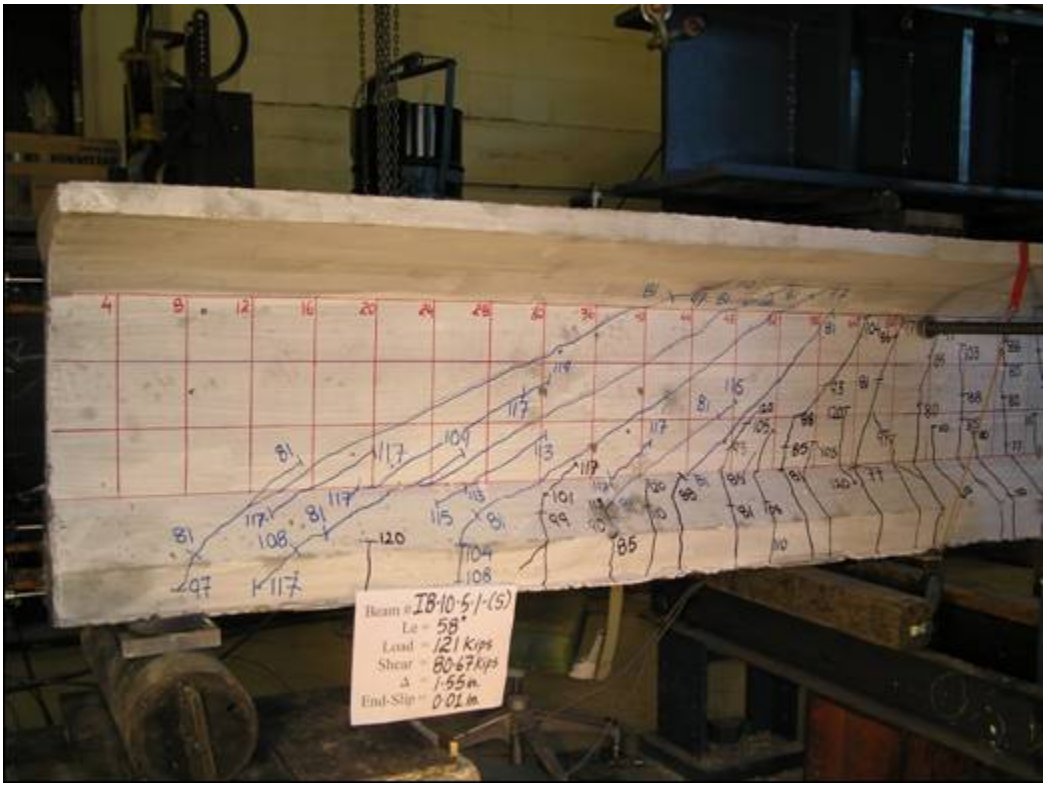


Photo of South end of beam IB-10-5-1 showing the cracking pattern at the maximum load

BEAM NAME: ID-6-5-1
END: ***NORTH***
DATE: 09/19/2005

TEST PARAMETERS	
Concrete Compressive Strength	**9840 psi**
Embedment Length(L_e)	**72 in.**
Span	**222 in.**
Failure Mode	**Bond Failure**
Maximum Load	**80.4 kips**
Maximum Shear	**53.6 kips**
Maximum Moment	**3537.6 kip-in**
Maximum Deflection attained	**2.5 in.**
Rebound after complete unloading	**1.4 in.**
Average NASP P.O value for strand "D"	**6.89 kips**

	Transfer lengths (in.) for beam # ID-6-5-1		
		At Release	At the time of testing
North	Top	36.25	73.1
	Middle	28.96	36.99
	Bottom East	24.47	35.34
	Bottom Central	26.69	55.05
	Bottom West	23.47	32.71

TEST SUMMARY

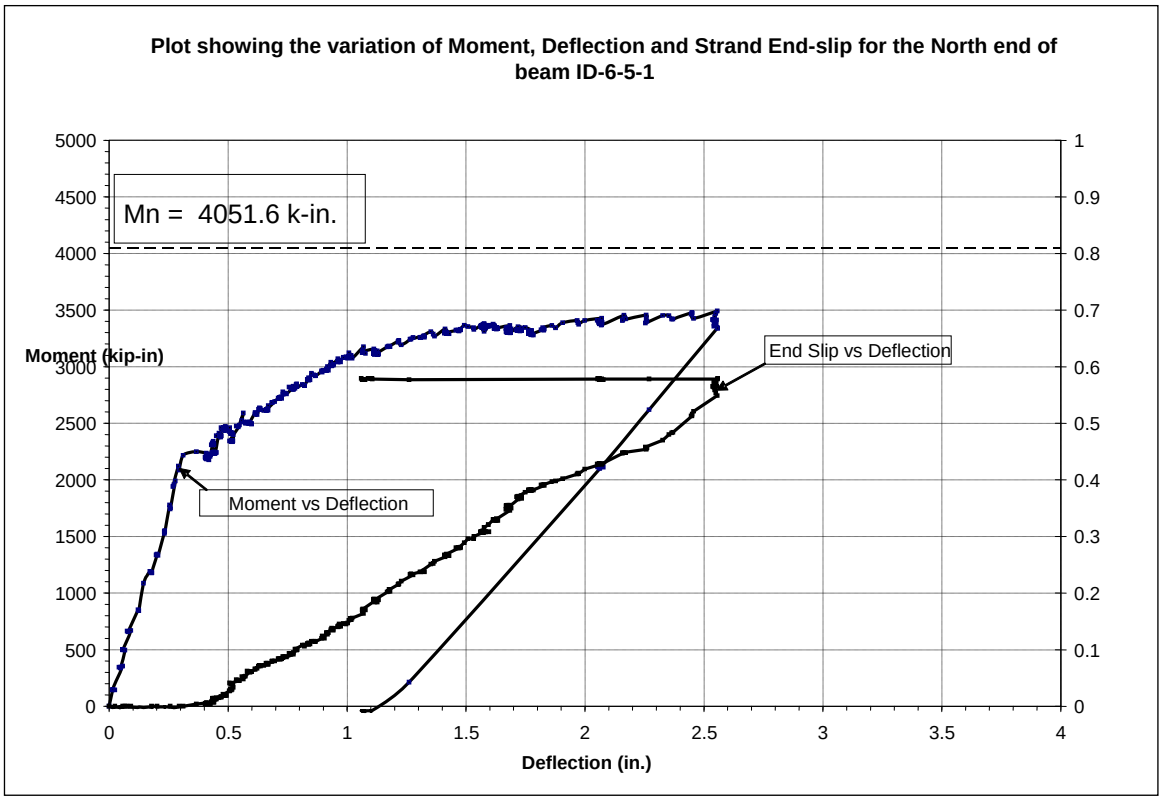
Load was applied in approximate 4.0 k increments until first flexural cracking. Beyond this point the beam was loaded to increase deflection by increments of 0.025 in. After total deflection reached 1.0 in., deflection was increased in increments of 0.05 in. DEMEC readings were taken at all load increments at both faces (East and West) with the rectangular rosette pattern at 36 in. from the end being tested.

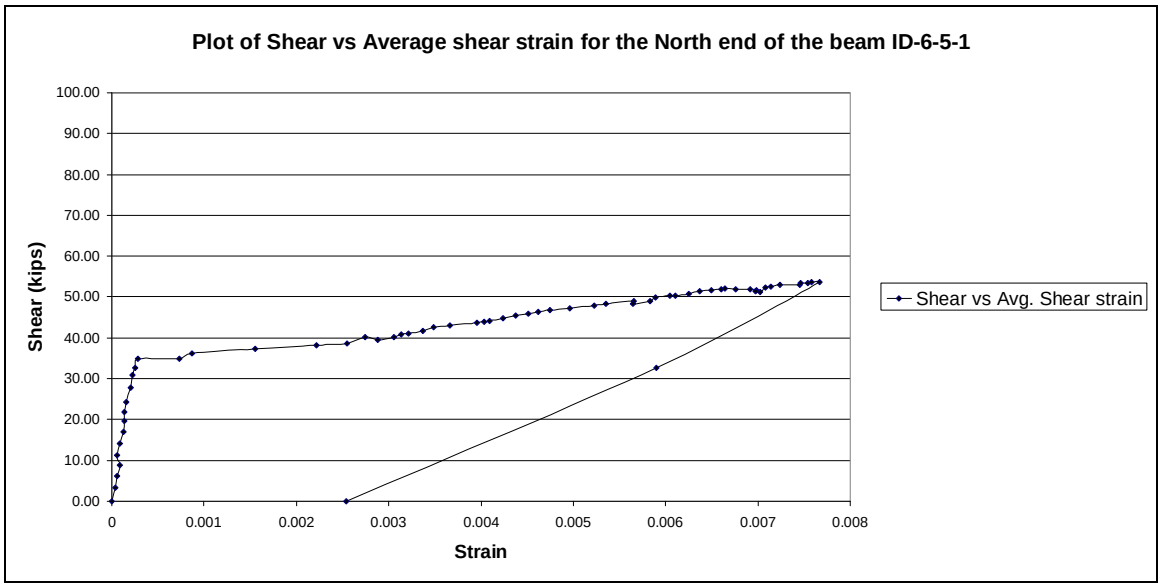
First flexural cracks were observed at the load of 49 kips (Shear = 32.7 kips) and deflection of 0.3 in. when a pair of cracks formed at locations approximately below the two load points. First web shear cracks were observed at the load of 52.4 kips (Shear = 34.9 kips; Δ = 0.35 in.). The first web shear cracks occurred in the form of two cracks almost parallel to each other in the shear zone. The load dropped to 51.5 kips and the DEMEC points were taken at the reduced load i.e. after the cracks were completely formed.

An inclined flexural crack was observed at Station 24 at the load of 54.2 kips (Shear = 36.1 kips; Δ = 0.38 in.). At the same time, first end slip of 0.01 in. was noticed. The load dropped to a value of 51.9 kips (Shear = 34.6 kips). After this point, the strand end slip values increased gradually at every each load increment. The deflection increments were

continued till the total end slip value reached 0.8 in. It was observed that the load remained fairly steady at around 80.4 kips while the deflection and end slip readings continued to increase at every increment. End slip reading at the South end remained at 0.00 in. throughout the loading and unloading cycles.

The beam exhibited a BOND FAILURE in that strand slippage prevented further increases in beam capacity. The flexural moment achieved during the test was only 3500 k-in., or about 82% of the nominal flexural capacity. Likewise, the maximum shear achieved by the beam was only 53.6 k which is well below the 74.4 k of shear that resulted in a shear failure in the companion beam IB-6-5-1-N. Clearly, slippage of the strand and bond failure prevented the beam from achieving its calculated design capacity.





(In all the photographs presented below, cracks marked in black represent the ones originated as flexural cracks while those marked in blue represent the web shear cracks. Red color was used only for marking the grid lines and station points. Number written in red should not be confused with the load values.)

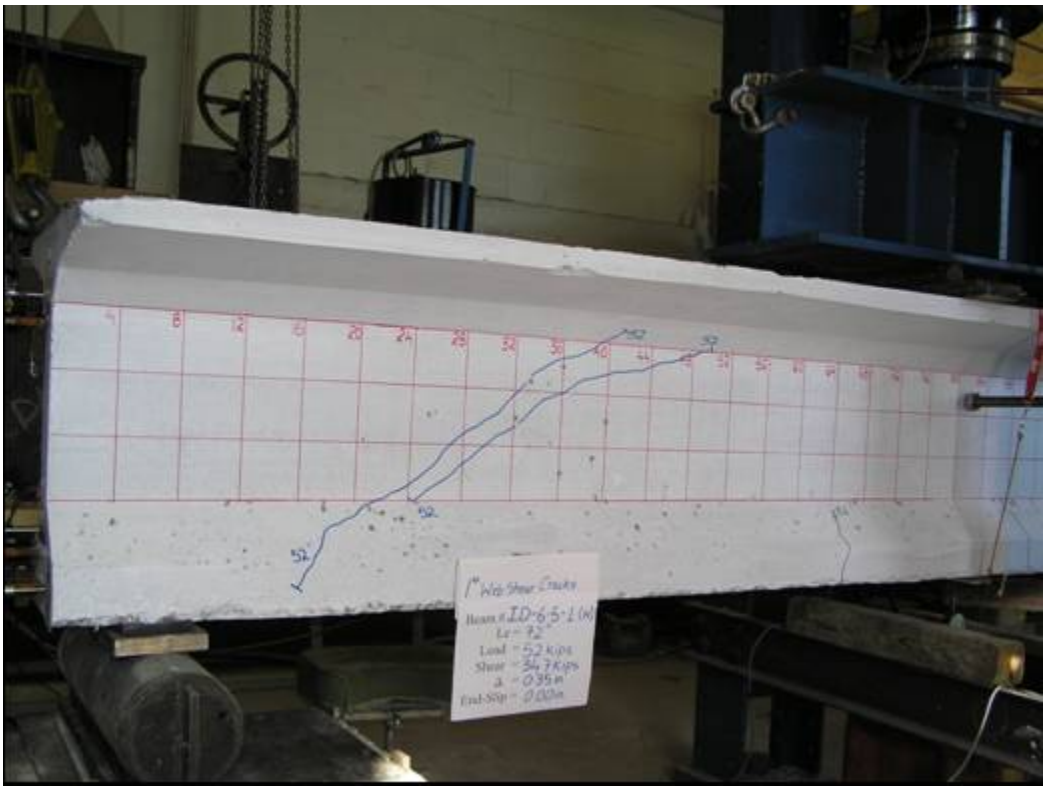


Photo of the North end of the beam ID-6-5-1 showing the first web shear cracking

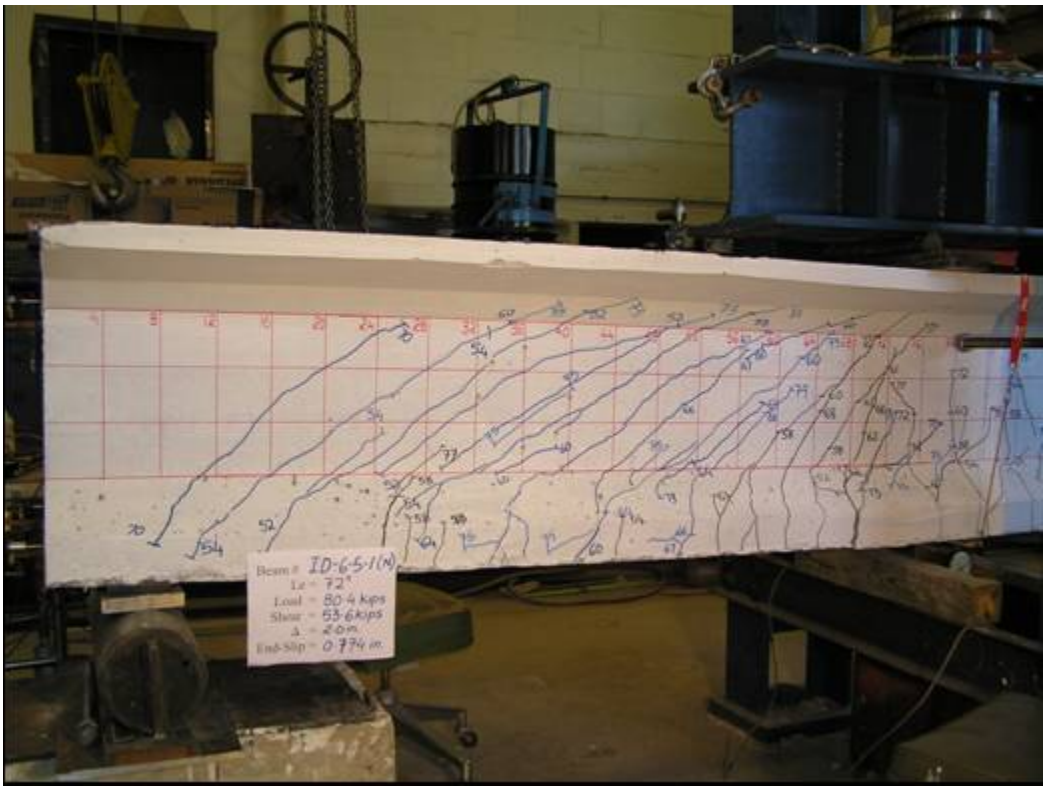


Photo of North end of beam ID-6-5-1 showing the cracking pattern at the maximum load

BEAM NAME: ID-6-5-1
END: ***SOUTH***
DATE: 09/23/2005

TEST PARAMETERS	
Concrete Compressive Strength	**9840 psi**
Embedment Length(L_e)	**88 in.**
Span	**270 in.**
Failure Mode	**Bond**
Maximum Load	**60 kips**
Maximum Shear	**40 kips**
Maximum Moment	**3280 kip-in.**
Maximum Deflection attained	**3.5 in.**
Rebound after complete unloading	**2.0 in.**
Average NASP P.O value for strand "B"	**6.89 kips.**

	Transfer lengths (in.) for beam # ID-6-5-1		
		At Release	At the time of testing
South	Top	29.99	68.63
	Middle	11.04	26.67
	Bottom East	12.23	46.22
	Bottom Central	NA	NA
	Bottom West	2.56	9.1

TEST SUMMARY

North end test of the beam ID-6-5-1 resulted in total end-slip of 0.8 in. and a BOND FAILURE. To avoid any further end slip at the North end while the South end was tested, prestressing strand chucks were fixed to the strands at the North end of the beam. The chucks holding the strands in place are shown in the following photograph.

Load was increased by 2.5 kips with every increment until the first flexural cracks were observed. After cracking was observed, deflection was increased in increments of 0.025 in. After total deflection reached 1.0 in., deflection was increased in increments of 0.05 in. After total deflection reached 1.8 in. deflection was increased in increments of 0.10 in. DEMEC readings were taken at all load increments at both faces (East and West) with the rectangular rosette pattern at 36 in. from the end being tested.

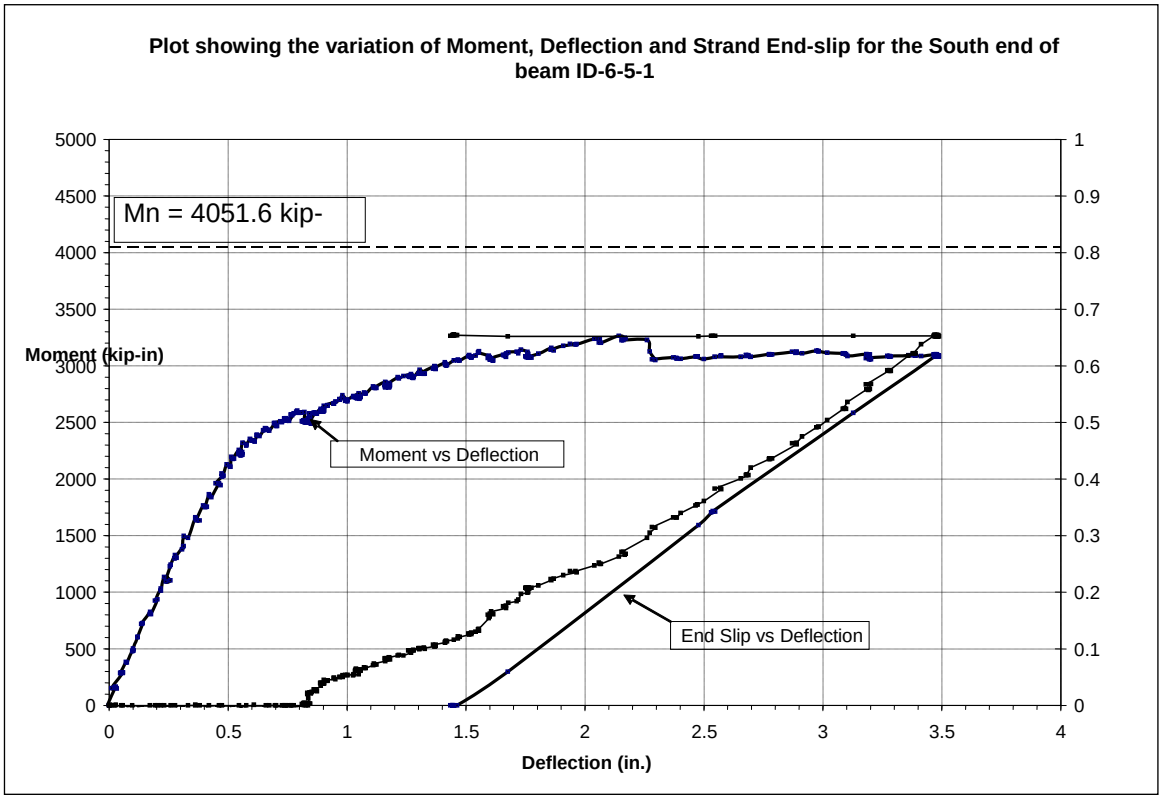
First flexural cracking was observed at the load of 41.7 kips (Shear = 27.8 k; Δ = 0.58 in.). The first flexural cracking was in the form of a single crack formed approximately at the center of span. No significant drop of load was noticed at this point. First web shear cracking was observed at the load of 48.6 kips (Shear = 32.4 k; Δ = 0.85 in.). First web shear cracks were in the form of a number of diagonal cracks fairly parallel to each other

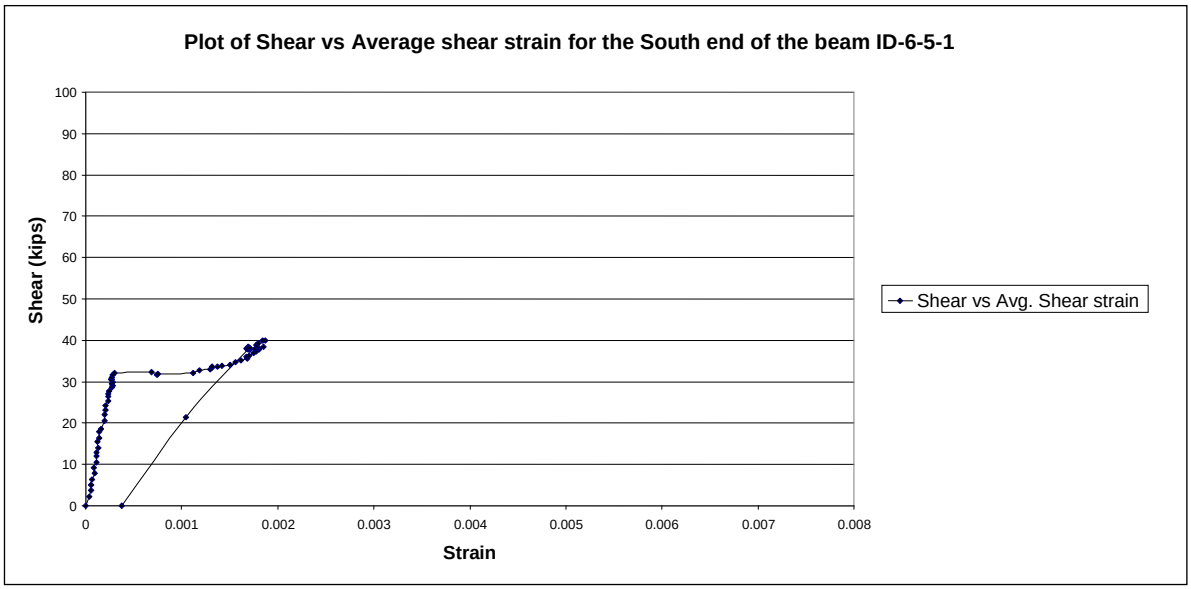
in the shear zone. Load value dropped to 45.8 kips at this stage. DEMEC readings were taken after the cracks were completely formed. First end slip of 0.01 in. was noticed at the East strand at this point.

As the load increased from 45.8 kips to 47.6 kips (Shear = 31.7 k; Δ = 0.88 in.), first end slip of 0.01 in. the middle strand was observed. First inclined flexural cracks were noticed at Stations 24 and 28. Along with these inclined flexural cracks, new shear cracks were formed at this load and the load value dropped further to 45.7 kips (Shear = 30.5 k; Δ = 0.88 in.). The values for end slip increased with every load increment.

Maximum load attained was 60.0 kips (Shear = 40 k; Δ at maximum load = 2.3 in.) when an audible crack was observed and the load decreased to 56.6 kips. After this load increment, additional loadings failed to produce any higher loads. Deflection increments were stopped when the maximum end slip reached 0.75 in. (at the East strand) and maximum end slip of 0.74 in. at the middle strand.

The beam exhibited a BOND FAILURE in that strand slippage prevented further increases in beam capacity. The flexural moment achieved during the test was only 3500 k-in., or about 81% of the nominal flexural capacity. Likewise, the maximum shear achieved by the beam was only 53.6 k which is well below the 74.4 k of shear that resulted in a shear failure in the companion beam IB-6-5-1-N. Clearly, slippage of the strand and bond failure prevented the beam from achieving its calculated design capacity.





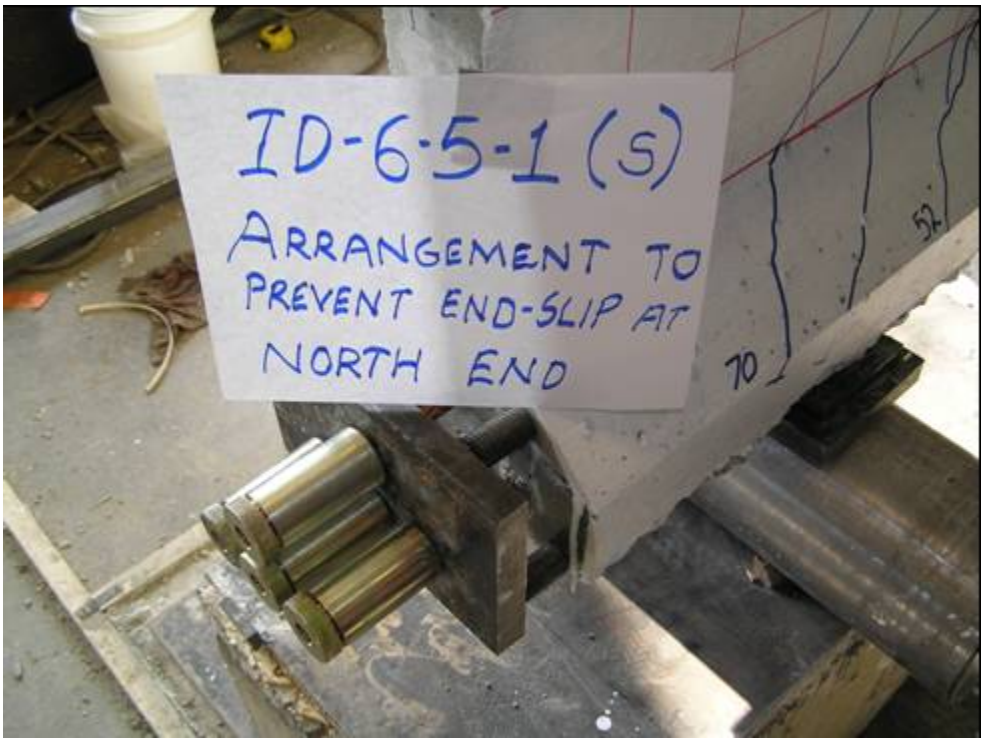


Photo showing chucks attached to strands to prevent any possible end slip.

(In all the photographs presented below, cracks marked in black represent the ones originated as flexural cracks while those marked in blue represent the web shear cracks. Red color was used only for marking the grid lines and station points. Number written in red should not be confused with the load values.)

Photo of the South end of the beam ID-6-5-1 showing the first web shear cracking

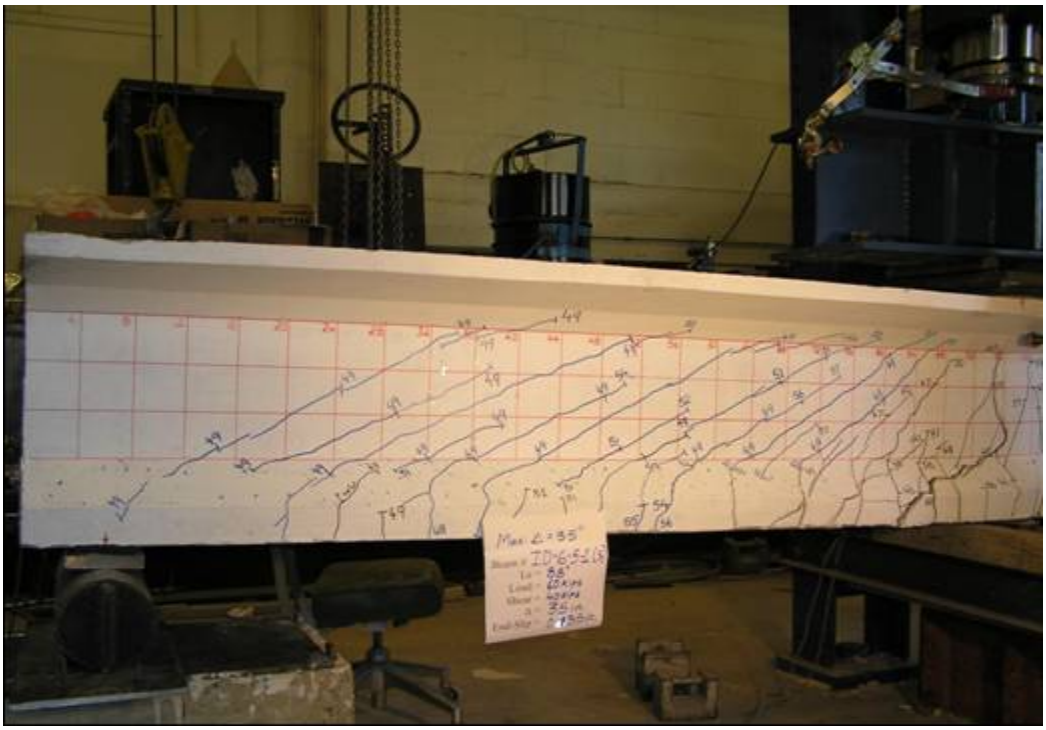


Photo of South end of beam ID-6-5-1 showing the cracking pattern at the maximum deflection

BEAM NAME: ID-10-5-1
END: NORTH
DATE: 09/30/2005

Concrete Compressive Strength	**14160 psi**
Embedment Length(L_e)	**88 in.**
Span	**270 in.**
Failure Mode	**Flexure**
Maximum Load	**73.6 kips**
Maximum Shear	**49.1 kips**
Maximum Moment	**4026.2 kip-in**
Maximum Deflection attained	**5.2 in.**
Rebound after complete unloading	**2.9 in.**
Average NASP P.O value for strand "D"	**6.89 kips**

	Transfer lengths (in.) for beam # ID-10-5-1		
		At Release	At the time of testing
North	Top	NA	NA
	Middle	23.51	41.86
	Bottom East	19.03	29.63
	Bottom Central	15.99	38.93
	Bottom West	23.51	40.4

TEST SUMMARY

The South end was tested after the North end. Strand end slip at the South end was prevented with the assembly of chucks as shown in the figure under the testing summary for Beam ID-6-5-1 South.

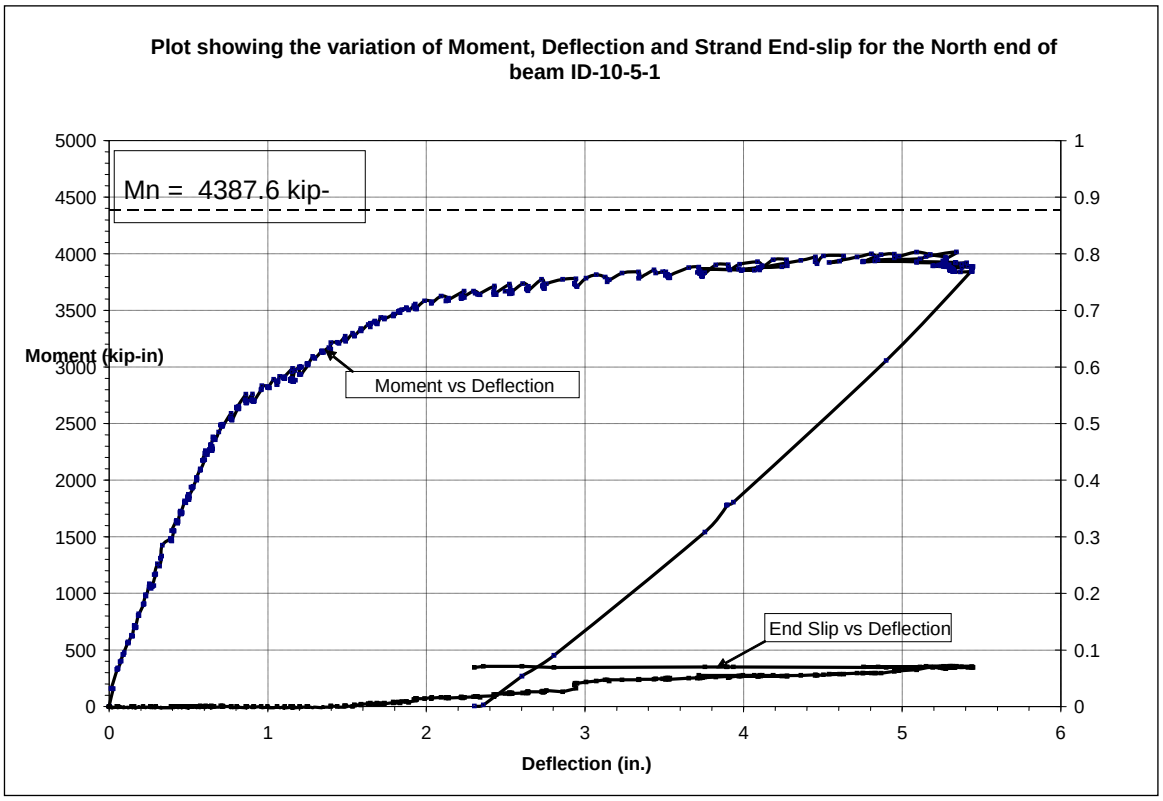
Load was applied in approximately 2.5 kips increments till first flexural cracking. Beyond this point the deflection was incremented by 0.025 in. till total deflection reached 0.7 in. Further increments of deflection were kept 0.05 in till total deflection of 2.0 in. Finally deflection was incremented by 0.1 in till maximum deflection was attained. DEMEC readings were taken at all load increments at both faces (East and West) with the rectangular rosette pattern at 36 in from the end being tested.

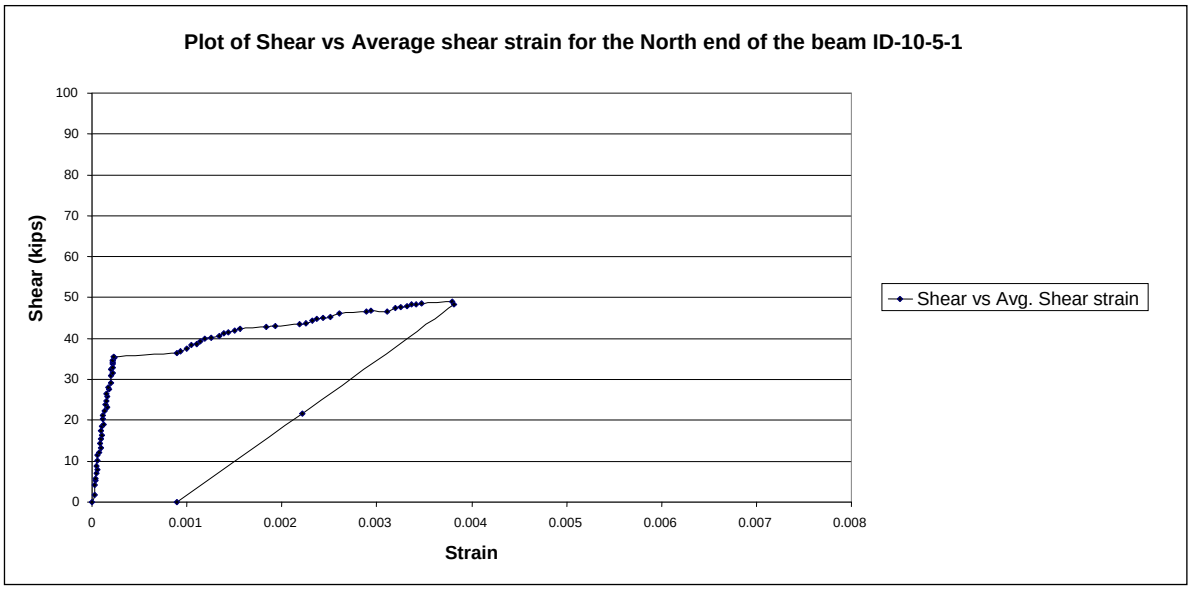
Since North end was tested after the South end, initially cracks were seen to propagate from the pre-existing cracks even before the first flexural cracks were noticed. First flexural cracks were observed at 48.7 kips (Shear = 32.5 kips; Δ = 0.85 in.) at Stations 88, 92 and 120. First secondary cracks followed at the load of 50.9 kips (Shear = 34 k; Δ= 0.95 in.) and were formed at St. 104 and Stn.108. The load value dropped to 49.3 kips after the secondary cracks were formed.

First web shear cracking was noticed at 54.6 kips (Shear = 36.4 k; Δ= 1.2 in.). The first web shear cracks occurred in the form of a number of diagonal cracks fairly parallel to each other in the shear zone. All cracks right from the first flexural cracks were clearly audible.

At 55.4 kips (Shear = 37 k; Δ= 1.3 in.) first end slip of 0.01 in. was noticed on the middle strand. Strand end slips increased gradually to a maximum of about 0.08 in.

Deflection increments were stopped since the hydraulic ram reached its maximum stroke. Complete failure was not attained, but from the values of load, deflection and end slip it was evident that the beam should be classified as a flexural failure.





(In all the photographs presented below, cracks marked in black represent the ones originated as flexural cracks while those marked in blue represent the web shear cracks. Red color was used only for marking the grid lines and station points. Number written in red should not be confused with the load values.)

Photo of the North end of the beam ID-10-5-1 showing the first web shear cracking

Photo of North end of beam ID-10-5-1 showing the cracking pattern at the maximum load

BEAM NAME: ID-10-5-1
END: ***SOUTH***
DATE: 09/28/2005

TEST PARAMETERS	
Concrete Compressive Strength	**14160 psi**
Embedment Length(L_e)	**72 in.**
Span	**222 in.**
Failure Mode	**Bond**
Maximum Load	**91.8 kips**
Maximum Shear	**61.2 kips**
Maximum Moment	**4039 kip-in**
Maximum Deflection attained	**3.7 in.**
Rebound after complete unloading	**2.1 in.**
Average NASP P.O value for strand "D"	**6.89 kips**

	Transfer lengths (in.) for beam # ID-10-5-1		
		At Release	At the time of testing
South	Top	16.86	35.81
	Middle	23.94	53.04
	Bottom East	19.03	22.84
	Bottom Central	21.13	57
	Bottom West	23.61	30.73

TEST SUMMARY

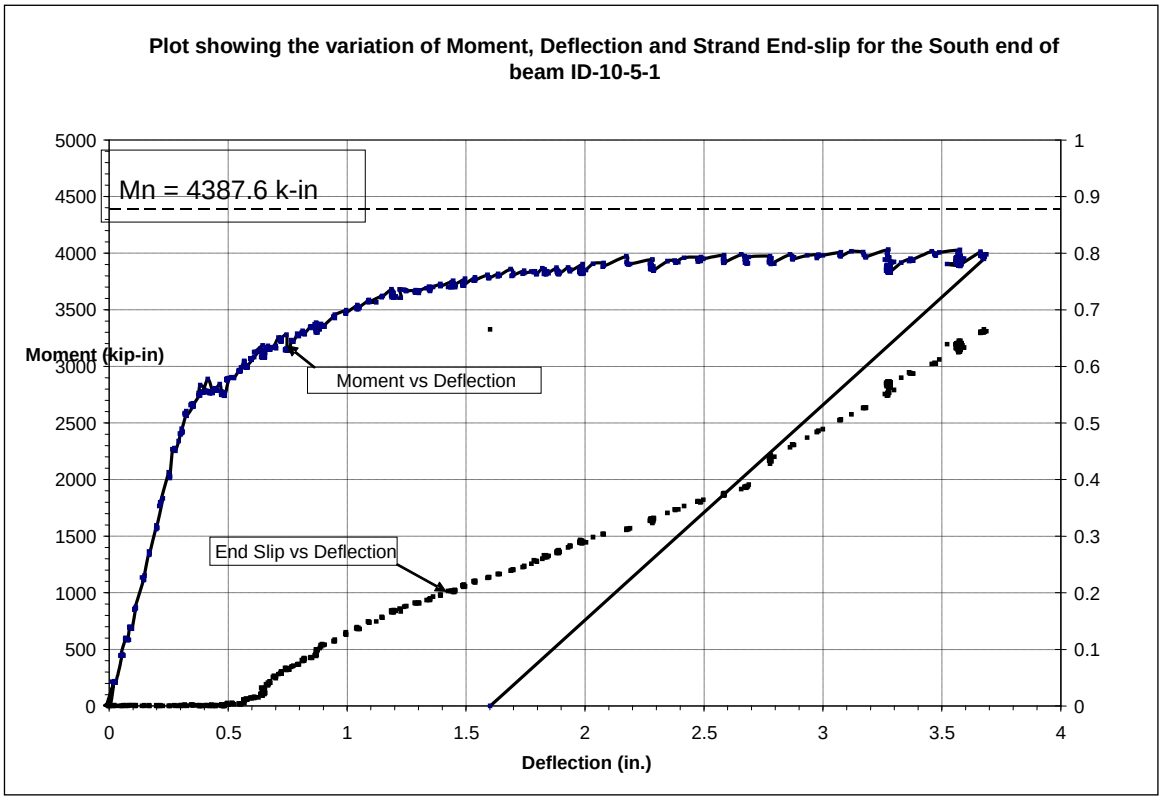
Load was applied in approximately 5.0 kips increments until first flexural cracking. Beyond this point the deflection was incremented by 0.025 in. until total deflection reached 0.9 in. From that point, increments of deflection were 0.05 in. until total deflection was 2.0 in. Finally deflection was incremented by 0.1 in. until maximum deflection was achieved. DEMEC readings were taken at all load increments at both faces (East and West) with the rectangular rosette pattern at 36 in from the end being tested.

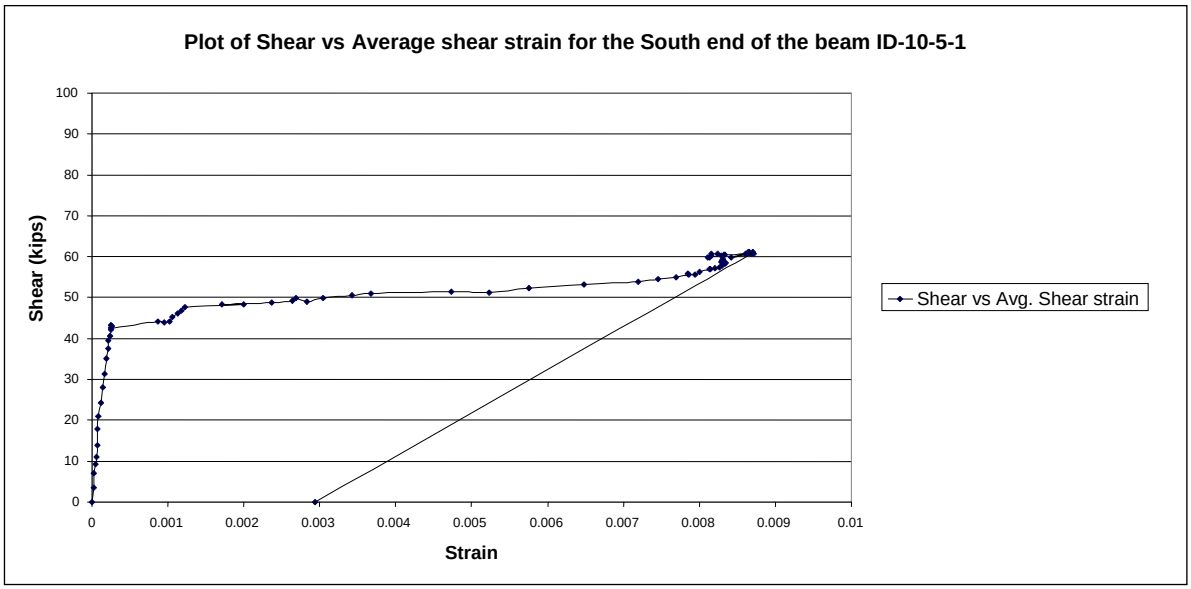
First flexural cracking was observed at the load of 56.3 kips (Shear = 37.5 k; Δ= 0.3 in.). Only a single crack was observed at this stage at the approximate midspan. A secondary crack was noticed at Station 88 at the load of 63.2 kips (Shear = 42.1 k; Δ = 0.38 in.).

At the load of 66.3 kips (Shear = 44.2 k; Δ= 0.48 in.) first web shear cracks were observed. Corresponding with web shear cracks, the value of load dropped to 62.4 kips. DEMEC readings were taken after the cracks were completely formed and at the lower value of load. First end slip of 0.01 in. was observed when the load returned to 66.3 k at a deflection = 0.53 in. End slip values continued to increase throughout the loading cycle till it reached maximum value of 0.71 in. at the deflection of 3.7 in.

As it was observed that the load values were not increasing, and with every increment only the end slip value was increasing, the loading was stopped as end slip value approached 3/4th in. End slip values at the North end remained 0.00 in. throughout the loading cycle.

The beam exhibited a BOND FAILURE in that strand slippage prevented further increases in beam capacity. The flexural moment achieved during the test was only about 92% of the nominal flexural capacity while the strand slippage was large and increasing.





(In all the photographs presented below, cracks marked in black represent the ones originated as flexural cracks while those marked in blue represent the web shear cracks. Red color was used only for marking the grid lines and station points. Number written in red should not be confused with the load values.)

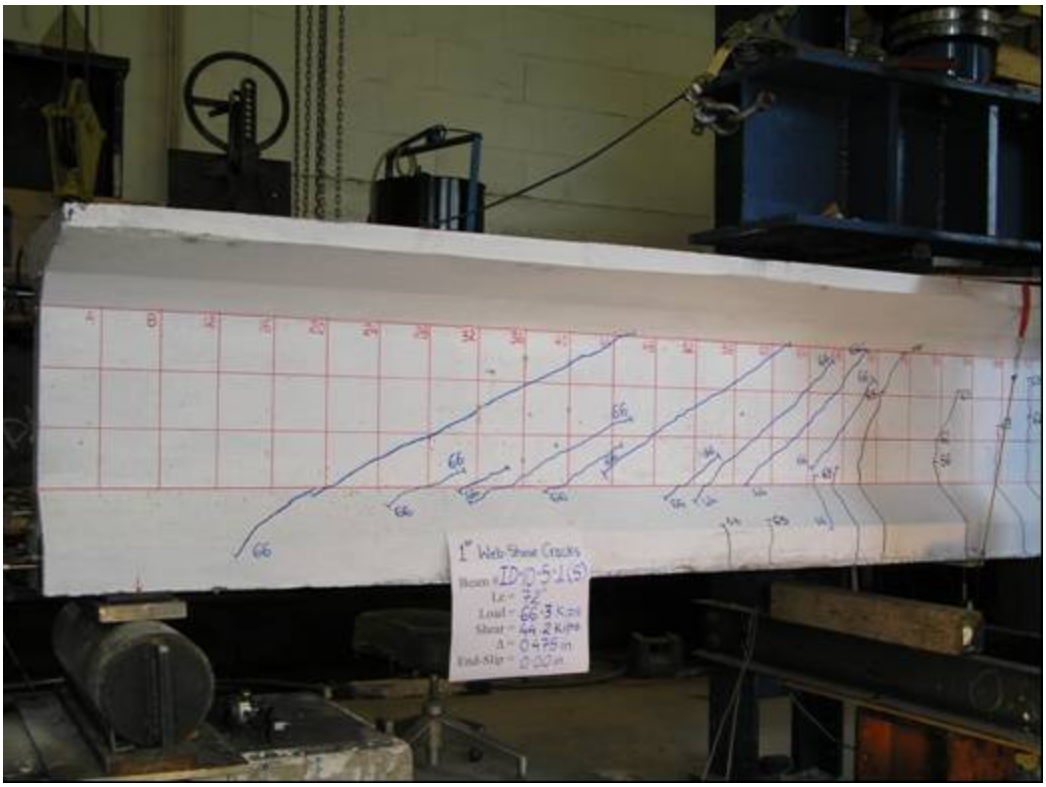


Photo of the South end of the beam ID-10-5-1 showing the first web shear cracking

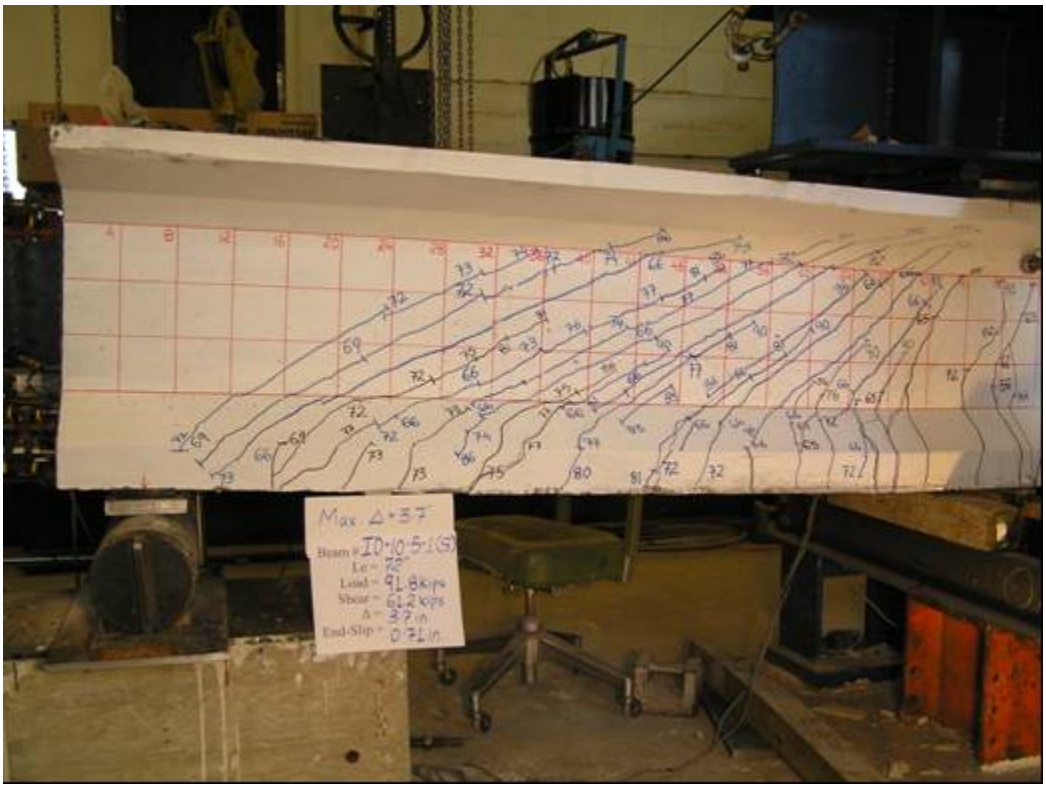


Photo of South end of beam ID-10-5-1 showing the cracking pattern at the maximum deflection