APPENDIX C

RECTANGULAR BEAM SUMMARIES—STRAND D

BEAM NAME: RD-4-5-1
END: NORTH
DATE: 07/21/2005

TEST PARAMETERS	
Concrete Compressive Strength	**7050 psi**
Embedment Length(L_e)	**73 in.**
Span	**162 in.**
Failure Mode	**Flexure**
Maximum Load	**23.3 kips**
Maximum Moment	**804 kip-in**
Deflection @ Failure	**3.3 in.**
Rebound after complete unloading	**2.3 in.**
Average Transfer Length (L_t) @ release	**32.8 in.**
@ time of testing	**38.6 in.**
Average NASP P.O value for strand "D"	**6.89 kips**

TEST SUMMARY

Load was applied in approximately 2.5 kips increments till first flexural cracking. Beyond this point the deflection was incremented by 0.03 in. till total deflection reached 1.00 in. Further increments of deflection were kept 0.05 in. till deflection of 2.0 in. Increments were set to 0.1 in. from this point up to failure.

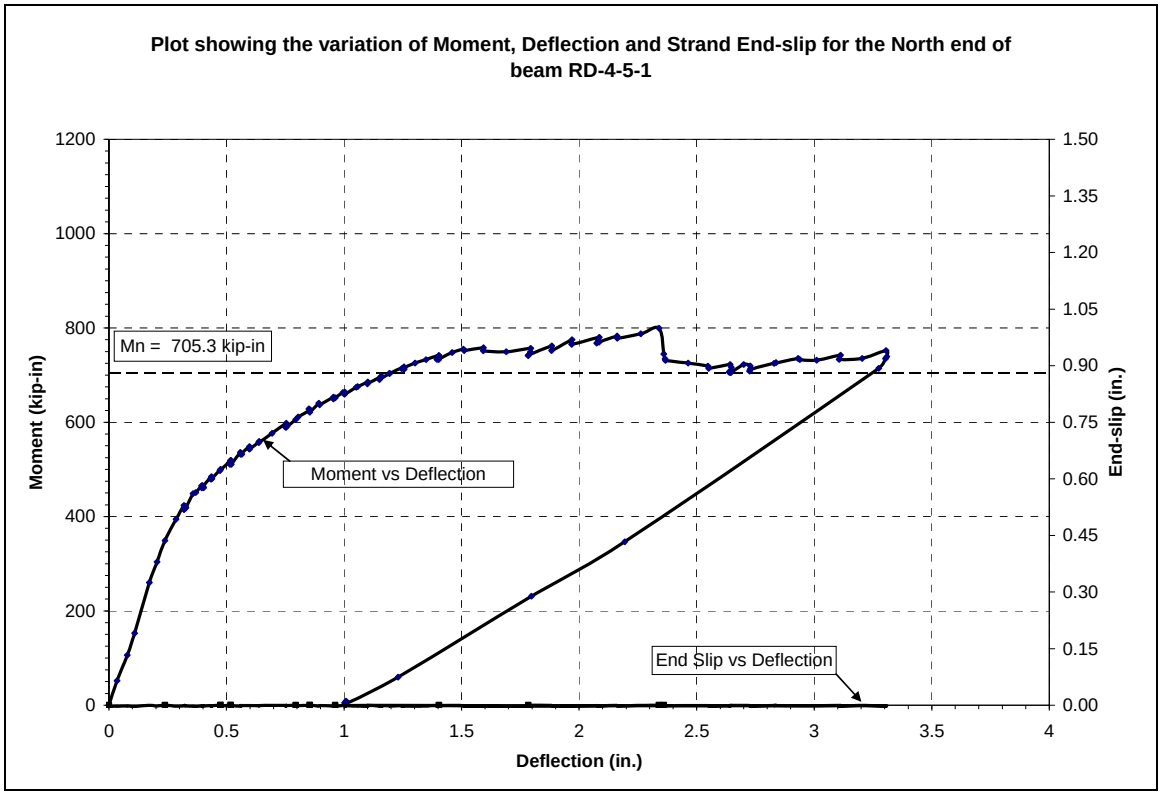
First flexural cracking occurred at a load of 12.3 kips (deflection 0.3 in.). The first flexural cracks formed at three spots, one of which was exactly under the point load whereas the other two were approximately equal distance from the central crack. With gradual loading these cracks propagated upward and diagonally towards the top rollers which were acting as two point loads.

No significant changes took place till the load reached a value of 22.3 kips (1.6 in. deflection). At this load cracks were clearly heard as the load was incremented. At load of 22.4 kips (2.3 in. deflection), cracks were heard for a longer time, hence sufficient time was allowed to pass before the next increment.

Cracks formed were being widened only on the South side of the beam. At this point it was noticed that one of the bottom rollers had rolled up to its limit and further horizontal displacement was stopped from both ends.

Concrete crushing failure was observed at a load of 21.5 kips. (deflection = 3.4 in.). Though the End-slip at the testing end (North) remained at 0.00 in, End-slip of 0.02 in. was observed at the South end.

Cracking pattern included 9 cracks in the middle 60 in. span with average crack spacing of 7.5 in. No inclined flexural crack was noticed.



Cracking pattern for Beam RD-4-5-1 being loaded at North end.

BEAM NAME: RD-4-5-1
END: SOUTH
DATE: 07/21/2005

TEST PARAMETERS	
Concrete Compressive Strength	**7050 psi**
Embedment Length(L_e)	**58 in.**
Span	**132 in.**
Failure Mode	**Flexure/Bond Failure**
Maximum Load	**28.1 kips**
Maximum Moment	**759 kip-in**
Deflection @ Failure	**1.6 in.**
Rebound after complete unloading	**1.0 in.**
Average Transfer Length (L_t) @ release	**31.0 in.**
@ time of testing	**42.3 in.**
Average NASP P.O value for strand "D"	**6.89 kips**

TEST SUMMARY

Load was applied in approximately 2.5 kips increments till first flexural cracking. Beyond this point the deflection was incremented by 0.03 in. till total deflection reached 1.00 in. Further increments of deflection were kept 0.05 in. till failure.

First flexural cracking occurred at a load of 17.0 kips while deflection at this point was noted as 0.2 in. The first flexural cracks formed at three spots, one of which was exactly under the point load whereas the other two were approximately equal distance from the central crack. With gradual loading these cracks propagated upward and diagonally towards the top rollers which were acting as two point loads.

Strand end-slip was first noted at the load of 20.5 kips (deflection 0.5 in.) then on end-slip continued as load was gradually increased. Also at the same load, a single large crack was observed approximately midway between the South end support and the first load point from that end.

The maximum deflection attained was 1.6 in. and maximum load value noted was 28.1 kips. At this point the load dropped suddenly to 25.1 kips. Though the maximum moment attained was 106% of the calculated value of nominal capacity, crushing of top surface of concrete was not observed.

This crack and the end-slip readings demonstrated the Bond Failure. Loading was immediately stopped as South end was the first end of this beam to be tested. Beam was unloaded and the deflection at zero load was found to be 0.6 in. However, End-slip was not recovered at all. The other end did not have any end-slip.

Crack pattern shows 7 flexural cracks in the middle 40 in. span with average crack spacing of 6.7 in. An inclined flexural crack was observed rising from Stn. 29 and Stn 32 and joining at approx. 3 in. from bottom to form a single crack.

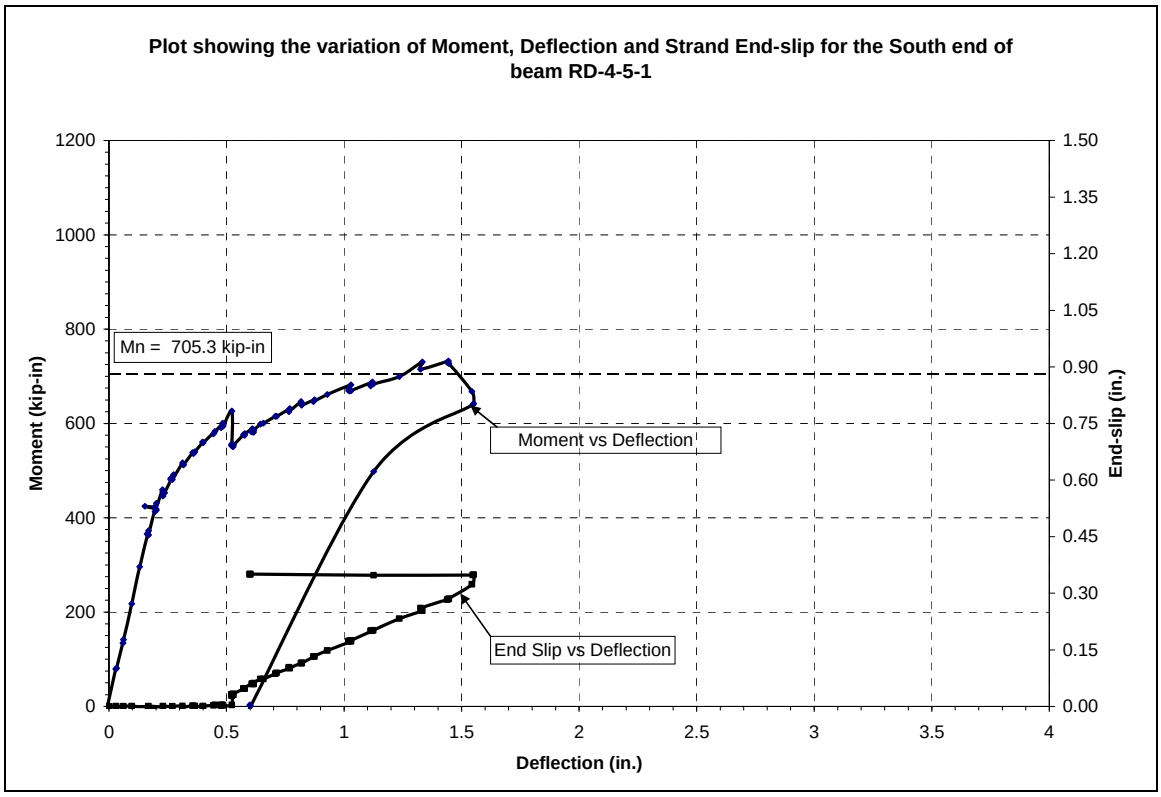


Photo Showing cracking pattern for Beam RD-4-5-1 being loaded at South end.

BEAM NAME: RD-4-5-2
END: NORTH
DATE: 07/25/2005

TEST PARAMETERS	
Concrete Compressive Strength	**7050 psi**
Embedment Length(L_e)	**73 in.**
Span	**162 in.**
Failure Mode	**Flexure**
Maximum Load	**24.1 kips**
Maximum Moment	**831 kip-in**
Deflection @ Failure	**2.7 in.**
Rebound after complete unloading	**1.7 in.**
Average Transfer Length (L_t) @ release	**32.8 in.**
@ time of testing	**63.1 in.**
Average NASP P.O value for strand "D"	**6.89 kips**

TEST SUMMARY

Load was applied in approximately 2 kips increments till first flexural cracking. Beyond this point the deflection was incremented by 0.03 in. till total deflection reached 1.00 in. Further increments of deflection were kept 0.05 in. up to 2.0 in. From this point till failure deflection increments were set to 0.1 in.

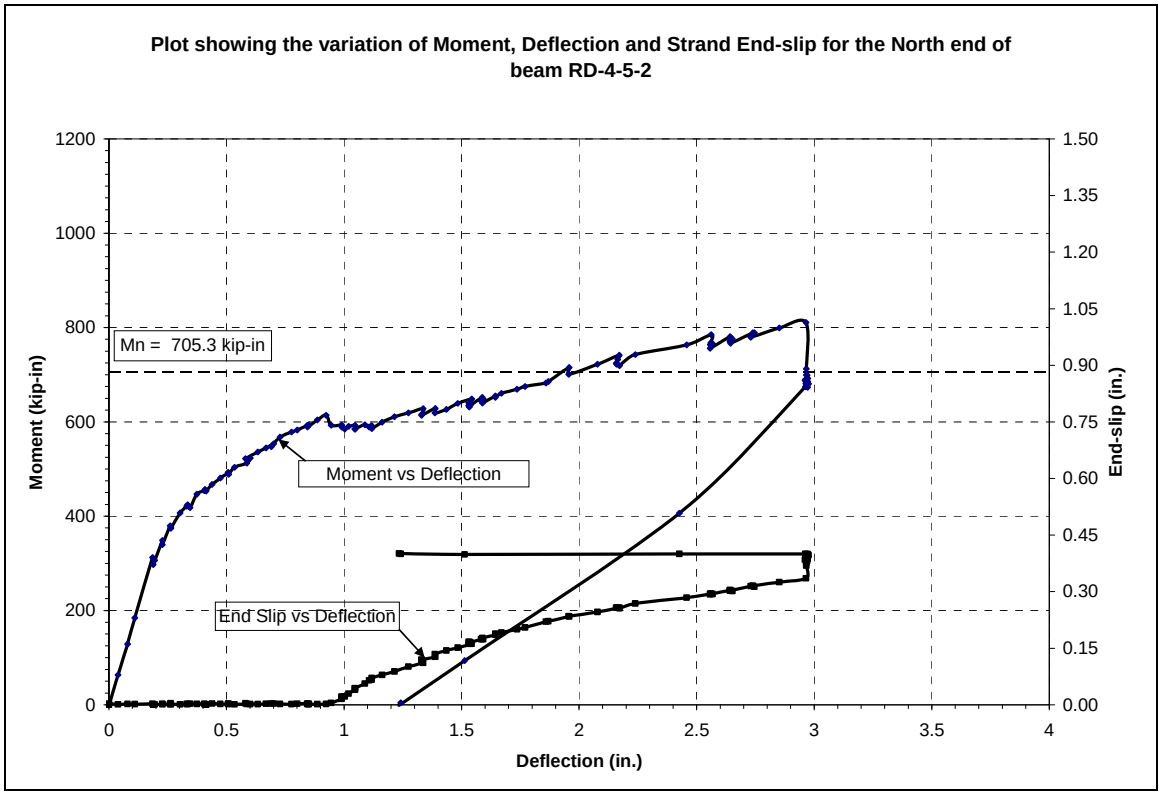
First flexural crack was observed at 11.2 kips at deflection of 0.3 in. Initially three cracks were noted at two point loads and at approximately midpoint of the two load points.

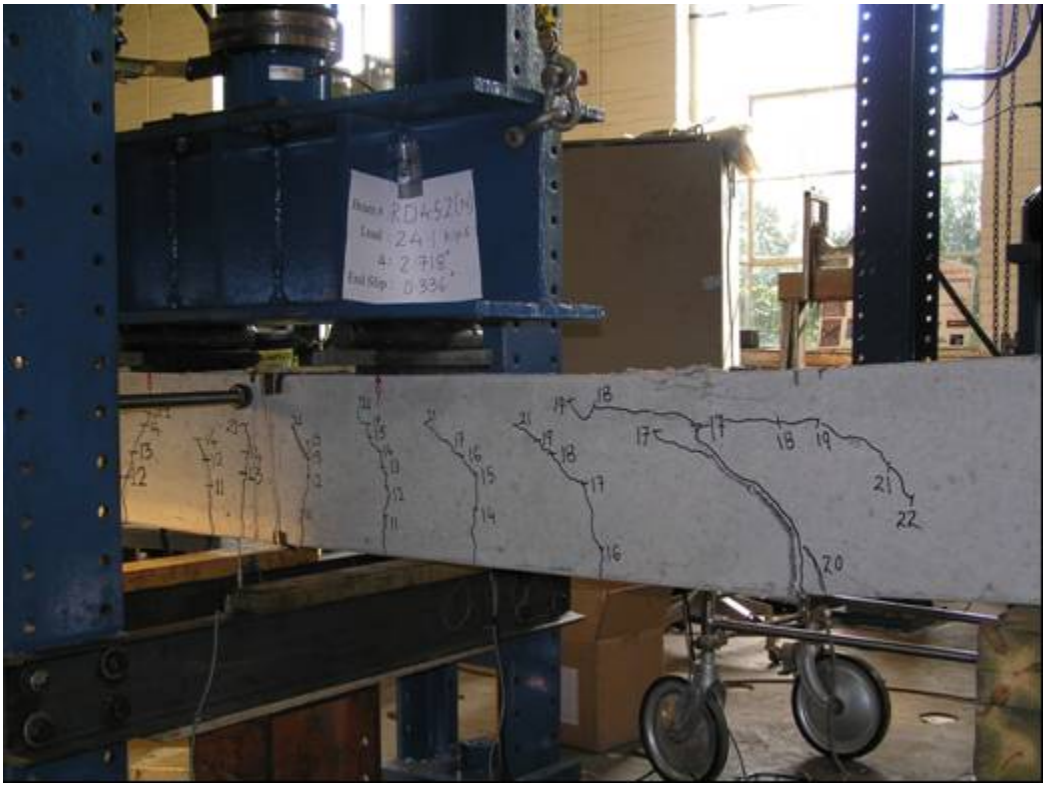
Another pair of flexural cracks was seen at 16.3 kips (deflection = 0.7 in.). At the load of 17.2 kips (deflection = 0.9 in) an inclined flexural crack was suddenly discovered at Stn. 41. At the same load and same deflection, first end-slip was noted as 0.02 in.

As the load reached 17.3 kips (deflection 1.0 in.), it was observed that the end-slip continued to increase without any further increments of load. Loading was halted for two minutes for allowing the end-slip to attain a constant value.

Loading was continued further and at 18.1 kips (deflection 1.2 in.) the inclined flexural crack appeared to grow in width drastically. Crack width continued to grow gradually from there on and as the load reached 24.1 kips (deflection 0.7 in.) end-slip of 0.0015 in. was noted on the South end. At the same load and deflection concrete crushing was observed at the top surface. After approximately 5 seconds another concrete crushing was noted with sudden spalling of concrete at the location where the inclined flexural crack reached its topmost position.

Cracking pattern included 9 flexural cracks in middle 59 in. span with average crack spacing of 7.4 in. An inclined flexural crack was noticed rising from Stn. 42 which later bifurcated (approx. 3 in. from the bottom) to Stn. 33.





Cracking pattern for Beam RD-4-5-1 being loaded at North end.

BEAM NAME: RD-4-5-2
END: SOUTH
DATE: 07/25/2005

TEST PARAMETERS	
Concrete Compressive Strength	**7050 psi**
Embedment Length(L_e)	**58 in.**
Span	**132 in.**
Failure Mode	**Bond Failure**
Maximum Load	**19 kips**
Maximum Moment	**513 kip-in**
Deflection @ Failure	**2.5 in.**
Rebound after complete unloading	**1.7 in.**
Average Transfer Length (L_t) @ release	**49.7 in.**
@ time of testing	**51.8 in.**
Average NASP P.O value for strand "D"	**6.89 kips**

TEST SUMMARY

Load was applied in approximately 2 kips increments till first flexural cracking. Beyond this point the deflection was incremented by 0.03 in. till total deflection reached 1.00 in. Further increments of deflection were kept 0.05 in. up to 2.0 in. From this point till failure deflection increments were set to 0.1 in.

First flexural crack was observed at 11.4 kips at deflection of 0.2 in. Initially only single crack was observed at midway between the two point loads. Two more cracks were noted at two point loads at 15.4 kips (deflection = 0.3 in.)

As the load reached 16.0 kips (0.3 in. deflection) another flexural crack was observed at the South side at Stn. 47. This crack inclined diagonally towards the South side point load grew in width with further loading while other flexural cracks propagated comparatively slower with increasing loads.

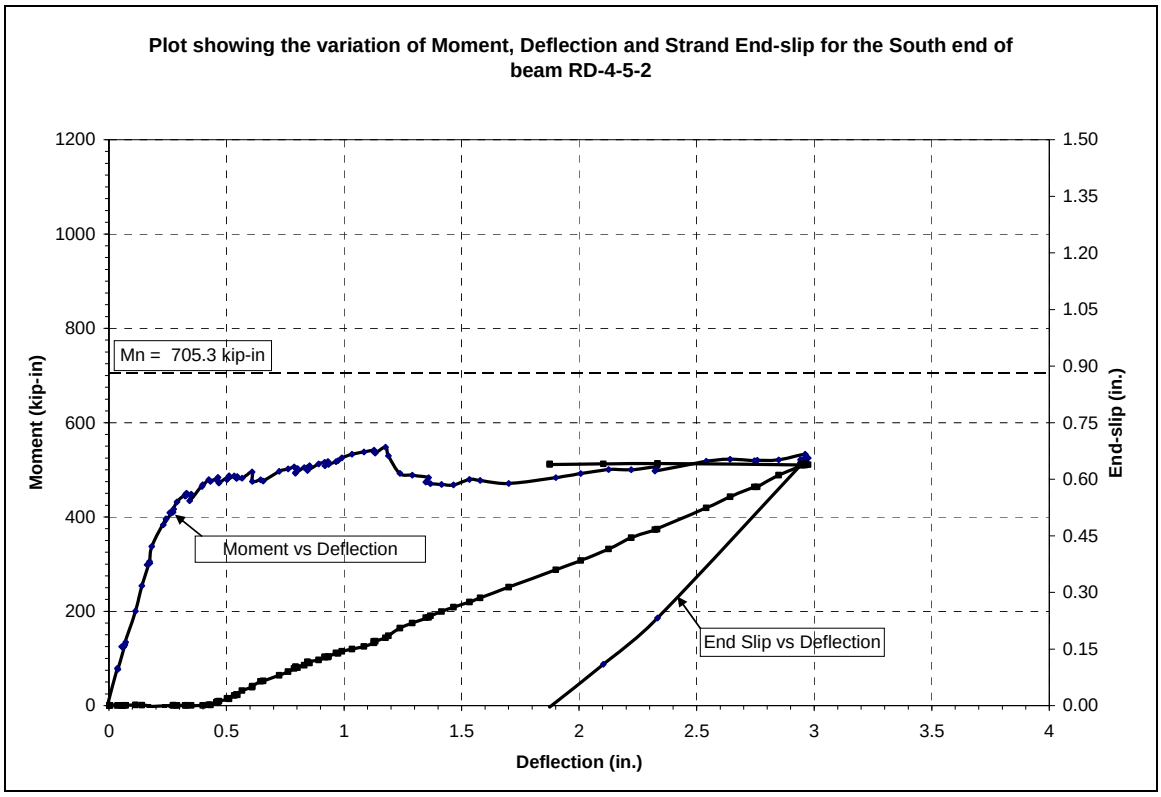
First end-slip of 0.01 in. was noted at 18.2 kips (0.5 in. deflection) and gradually increased with every load increment.

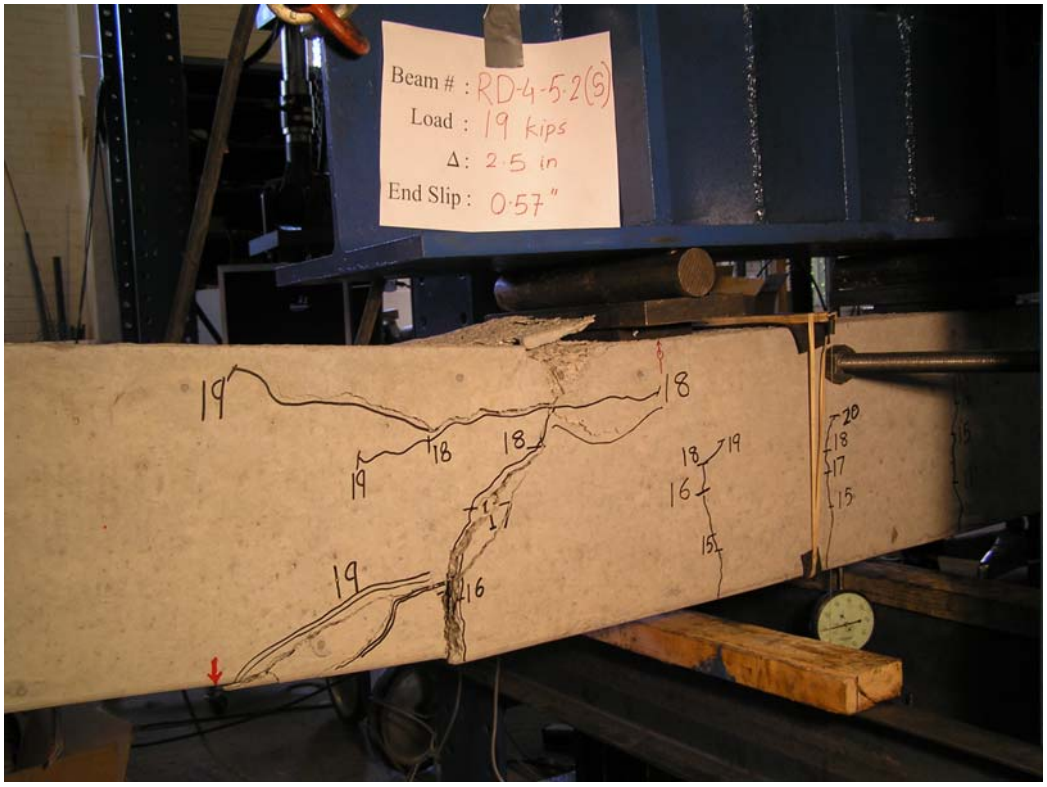
At 18.4 kips and deflection of 1.2 in. cracks were audible. Concrete above the topmost location of the inclined flexural crack started showing signs of crushing as it moved out of the top surface at the load of 17.8 in. (1.4 in deflection).Spalling of concrete at the same location started at this load and continued with increasing loads.

At the load of 19.3 kips (2.5 in. deflection) the beam gave a sudden jerk and concrete crushing was observed at the location where the inclined flexural crack reached its topmost point. This demonstrated the Bond failure. Maximum end-slip was 0.57 in.

End-slip at the North end remained 0.00 in. throughout the loading cycle.

There were 7 cracks in the middle 58 in. span with average crack spacing of 9.7 in. An inclined flexural crack was noticed at Stn. 47 which later bifurcated (approx. 4 in from the bottom) to Stn. 38.





Cracking pattern for Beam RD-4-5-2 being loaded at South end

BEAM NAME: RD-6-5-1
END: NORTH
DATE: 07/26/2005

TEST PARAMETERS	
Concrete Compressive Strength	**8500 psi**
Embedment Length(L_e)	**73 in.**
Span	**162 in.**
Failure Mode	**Flexure**
Maximum Load	**23.1 kips**
Maximum Moment	**797 kip-in**
Deflection @ Failure	**2.5 in.**
Rebound after complete unloading	**1.8 in.**
Average Transfer Length (L_t) @ release	**30.0 in.**
@ time of testing	**49.8 in.**
Average NASP P.O value for strand "D"	**6.89 kips**

TEST SUMMARY

Load was applied in approximately 1.5 kips increments till first flexural cracking. Beyond this point the deflection was incremented by 0.03 in. till total deflection reached 1.00 in. Further increments of deflection were kept 0.05 in. up to 2.0 in. From this point till failure deflection increments were set to 0.1 in.

First flexural crack was observed at 12.8 kips at deflection of 0.3 in. Initially three cracks were noted at two point loads and at approximately midpoint of the two load points.

As the load reached 18.5 kips (0.9 in deflection), first end-slip of 0.004 in. was noted. At the same load and deflection, a diagonally inclined flexural crack was observed rising from two points located at Stn. 38 and Stn. 35 from the North end and joining at 2.5 in. from bottom surface to form a single crack.

With the values of load going beyond 21.7 kips (deflection 1.7 in.), the first flexural crack from North end appeared to increase in width. Finally at the load of 23.1 kips (deflection 2.5 in.; max end-slip = 0.06 in.) concrete crushing failure was seen at the top surface of concrete.

Values of end-slip gradually went on increasing with load and deflection until concrete crushing failure occurred. At failure end-slip reading on the South end was 0.0015 in.

Since the concrete crushing occurred at the location of strain potential device, deflection readings for unloading cycle could not be noted. However, after complete unloading, deflection at 0.0 kips was noted using a dial gauge (deflection reading after complete unloading = 0.7 in.).

Cracking pattern included 11 cracks in the middle 59 in. span with average crack spacing of 5.9 in. An inclined flexural was noticed at Stn. 38

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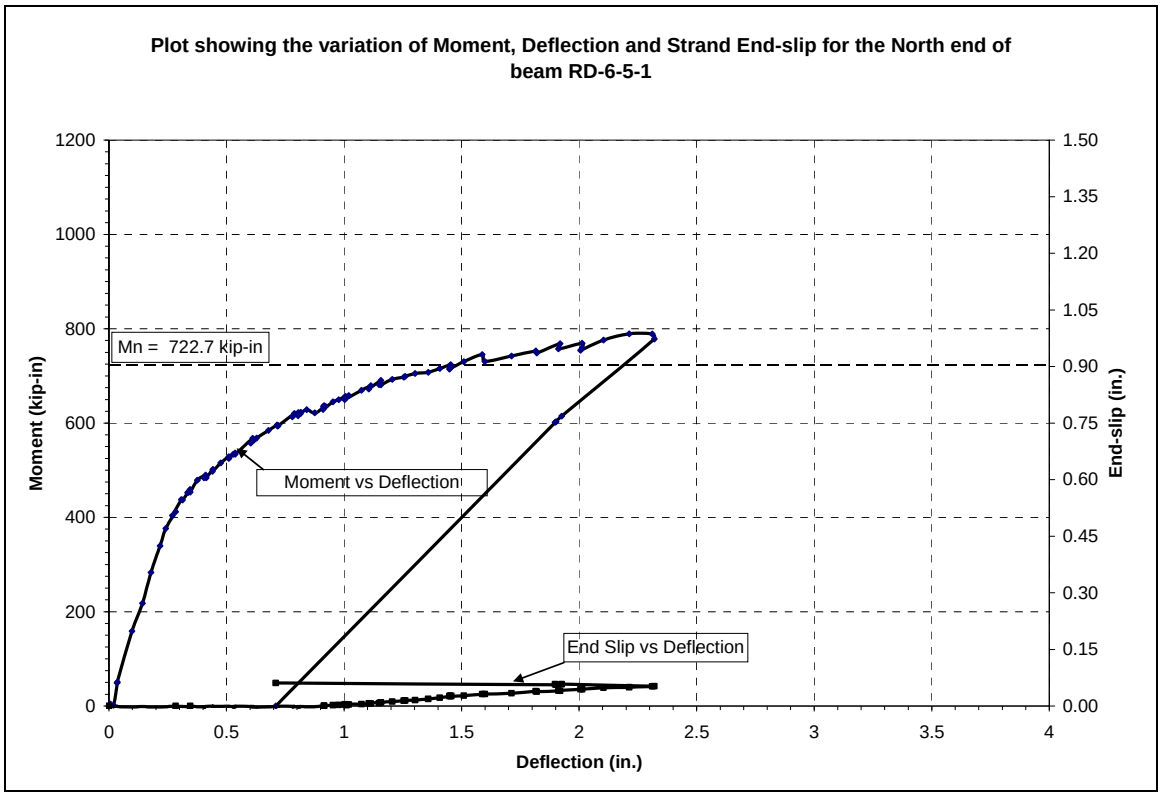
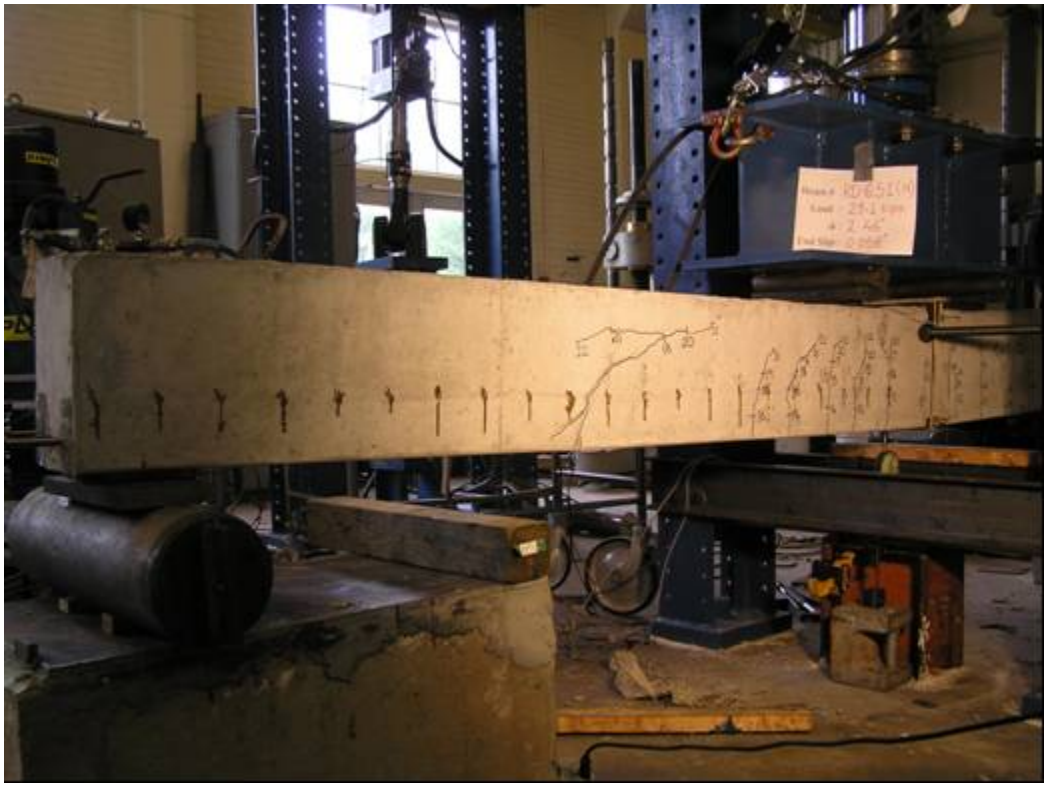




Cracking pattern for Beam RD-6-5-1 being loaded at North end.

BEAM NAME: RD-6-5-1
END: SOUTH
DATE: 07/27/2005

TEST PARAMETERS	
Concrete Compressive Strength	**8500 psi**
Embedment Length(L_e)	**58 in.**
Span	**132 in.**
Failure Mode	**Flexure**
Maximum Load	**29.2 kips**
Maximum Moment	**788 kip-in**
Deflection @ Failure	**2.0 in.**
Rebound after complete unloading	**1.3 in.**
Average Transfer Length (L_t) @ release	**28 in.**
@ time of testing	**45.3 in.**
Average NASP P.O value for strand "D"	**6.89 kips**

TEST SUMMARY

Load was applied in approximately 2 kips increments till first flexural cracking. Beyond this point the deflection was incremented by 0.03 in. till total deflection reached 1.00 in. Further increments of deflection were kept 0.05 in. up to 2.0 in. From this point till failure deflection increments were set to 0.1 in.

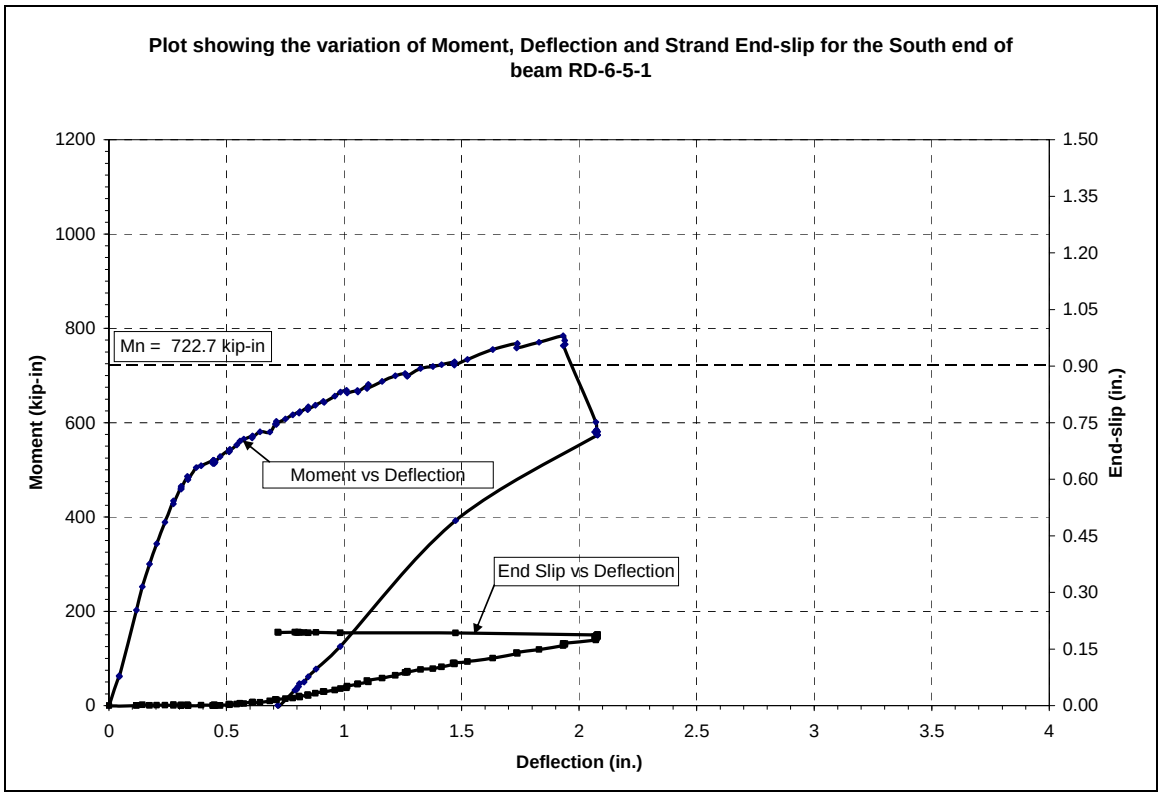
First flexural crack was observed at 17.2 kips at deflection of 0.3 in. Initially three cracks were noted at two point loads and at approximately midpoint of the two load points.

As the load reached 19.5 kips (0.4 in. deflection) a large inclined flexural crack was discovered at Stn. 39. First end-slip was noted as 0.006 in. at the first subsequent increment when load was 19.8 kips (deflection = 0.5 in.).

Cracks became audible at the load of 25.8 kips (1.2 in. deflection). End-slip at the load of 28.8 kips occurred with a clicking sound near the South end.

Concrete crushing failure was noted at the top surface of concrete at the load of 29.2 kips (deflection = 2.0 in.) Maximum end-slip noted at South end was 0.18in. The end-slip reading at the North end remained 0.00 in.

Cracking pattern shows 5 cracks in the middle 25 in. span with average crack spacing of 6.3 in. An inclined flexural crack was observed at Stn. 41. This crack went on to form a crack similar to another inclined flexural crack which did not reach the bottom surface. Distance between these two similar cracks was 16.5 in.



Cracking pattern for Beam RD-6-5-1 being loaded at South end.

BEAM NAME: RD-6-5-2
END: NORTH
DATE: 07/27/2005

TEST PARAMETERS	
Concrete Compressive Strength	**8500 psi**
Embedment Length(L_e)	**73 in.**
Span	**162 in.**
Failure Mode	**Flexure**
Maximum Load	**21.3 kips**
Maximum Moment	**735 kip-in**
Deflection @ Failure	**2.0 in.**
Rebound after complete unloading	**1.7 in.**
Average Transfer Length (L_t) @ release	**25.6 in.**
@ time of testing	**44.2 in.**
Average NASP P.O value for strand "D"	**6.89 kips**

TEST SUMMARY

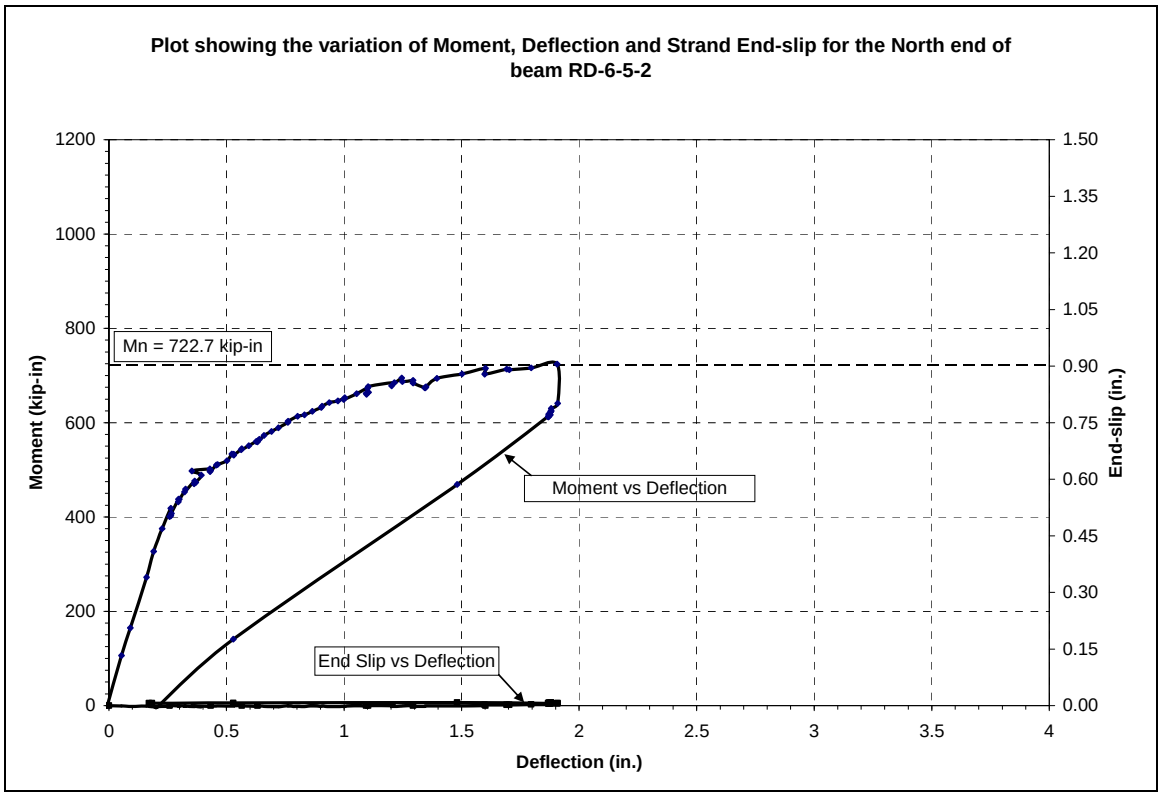
Load was applied in approximately 1.5 kips increments till first flexural cracking. Beyond this point the deflection was incremented by 0.03 in. till total deflection reached 1.00 in. Further increments of deflection were kept 0.05 in. up to 2.0 in. From this point till failure deflection increments were set to 0.1 in.

First flexural crack was observed at 12.3 kips at deflection of 0.27 in. Initially three cracks were noted at two point loads and at approximately midpoint of the two load points.

Cracks became audible at the load of 20.3 kips (deflection = 1.3 in.) and an inclined flexural crack was seen with a sudden cracking sound at the load of 20.6 kips (deflection = 1.4 in.) located at the Stn. 36.

First end-slip of 0.004 in. was noted at the load of 21.3 kips (1.6 in. deflection). As the load reached 21.3 kips (deflection 2.0 in.) concrete crushing failure was observed at the top surface. The maximum end-slip at failure = 0.01 in.

Cracking pattern included 8 cracks in the middle 56 in. span with average crack spacing of 8 in. Also an inclined flexural crack was noticed at Stn. 36.



Cracking pattern for Beam RD-6-5-2 being loaded at North end.

BEAM NAME: RD-6-5-2
END: SOUTH
DATE: 07/27/2005

TEST PARAMETERS	
Concrete Compressive Strength	**8500 psi**
Embedment Length(L_e)	**58 in.**
Span	**132 in.**
Failure Mode	**Bond Failure**
Maximum Load	**26.8 kips**
Maximum Moment	**724 kip-in**
Deflection @ Failure	**2.0 in.**
Rebound after complete unloading	**1.3 in.**
Average Transfer Length (L_t) @ release	**29.2 in.**
@ time of testing	**48.3 in.**
Average NASP P.O value for strand "D"	**6.89 kips**

TEST SUMMARY

Load was applied in approximately 2 kips increments till first flexural cracking. Beyond this point the deflection was incremented by 0.03 in. till total deflection reached 1.00 in. Further increments of deflection were kept 0.05 in. up to 2.0 in. From this point till failure deflection increments were set to 0.1 in.

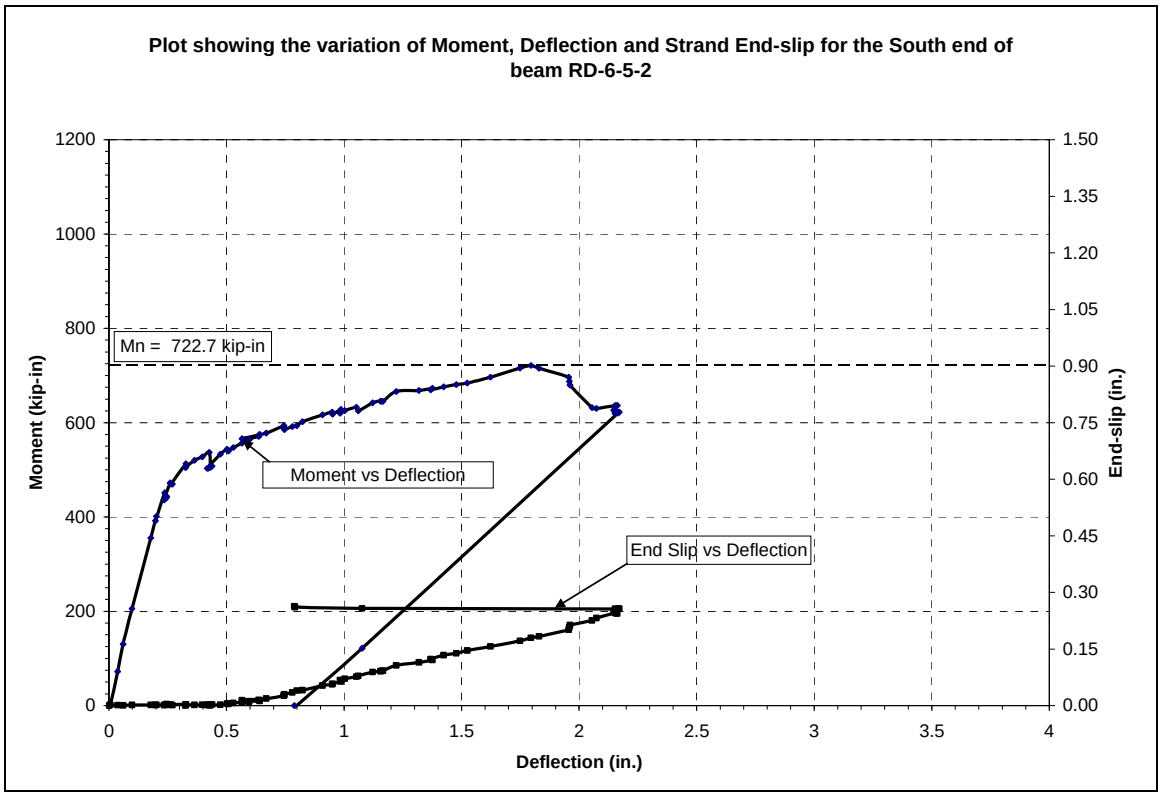
First flexural crack was observed at 16.5 kips at deflection of 0.2 in. Initially only two cracks were observed under the two point loads. Crack at midway between two point loads was discovered at 19.4 kips. (deflection = 0.4 in.)

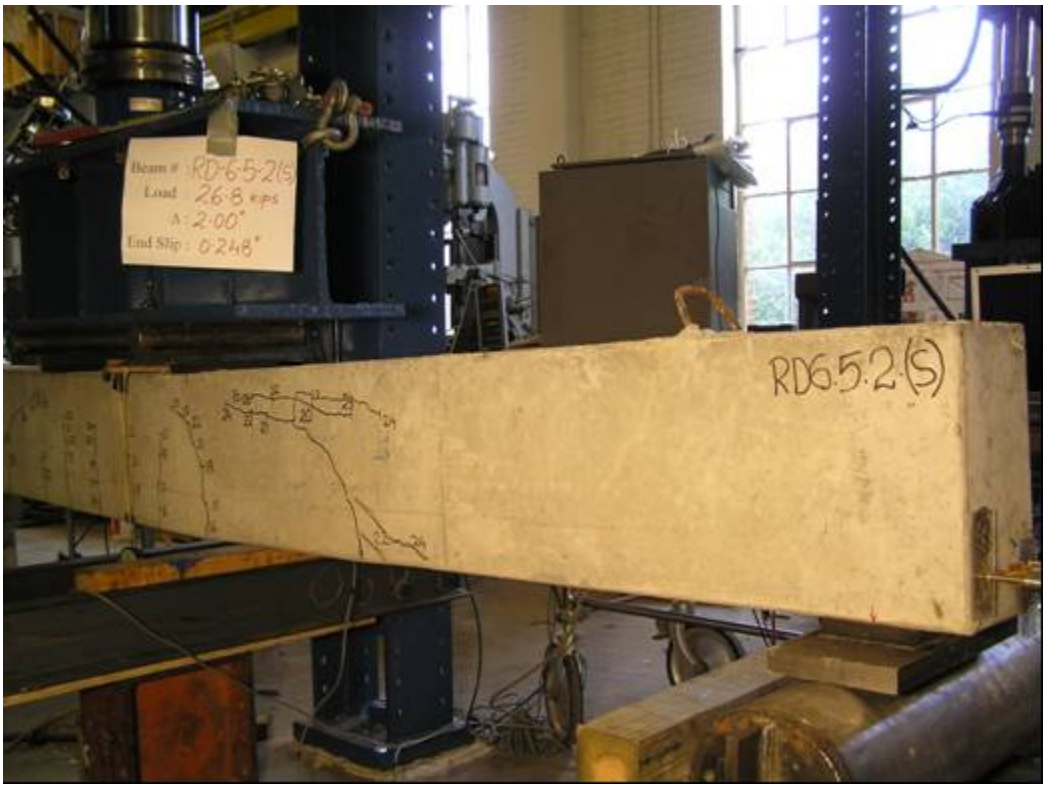
As the load reached 20.1 kips (0.4 in deflection), a diagonally inclined flexural crack was observed rising from Stn. 38. First end-slip of 0.03 in. was noted at the load of 21.3 kips.

Cracks were audible at the load of 23.4 kips (deflection 1.0 in.). Cracking became louder at the load of 26.8 kips (1.8 in. deflection) finally concrete crushing failure was noted at the deflection of 2.0 in.

Throughout the loading cycle, end-slip remained 0.00 in. at both ends.

Cracking pattern included 7 cracks in the middle 38 in. span with average crack spacing of 6.3 in. Also an inclined flexural crack was noticed at Stn. 38.





Cracking pattern for Beam RD-6-5-2 being loaded at South end.

BEAM NAME: RD-6A-5-1
END: NORTH
DATE: 08/02/2005

TEST PARAMETERS	
Concrete Compressive Strength	**11420 psi**
Embedment Length(L_e)	**73 in.**
Span	**162 in.**
Failure Mode	**Flexure**
Maximum Load	**23 kips**
Maximum Moment	**794 kip-in**
Deflection @ Failure	**2.3 in.**
Average Transfer Length (L_t) @ release	**35.4 in.**
@ time of testing	**39.9 in.**
Average NASP P.O value for strand "D"	**6.89 kips**

TEST SUMMARY

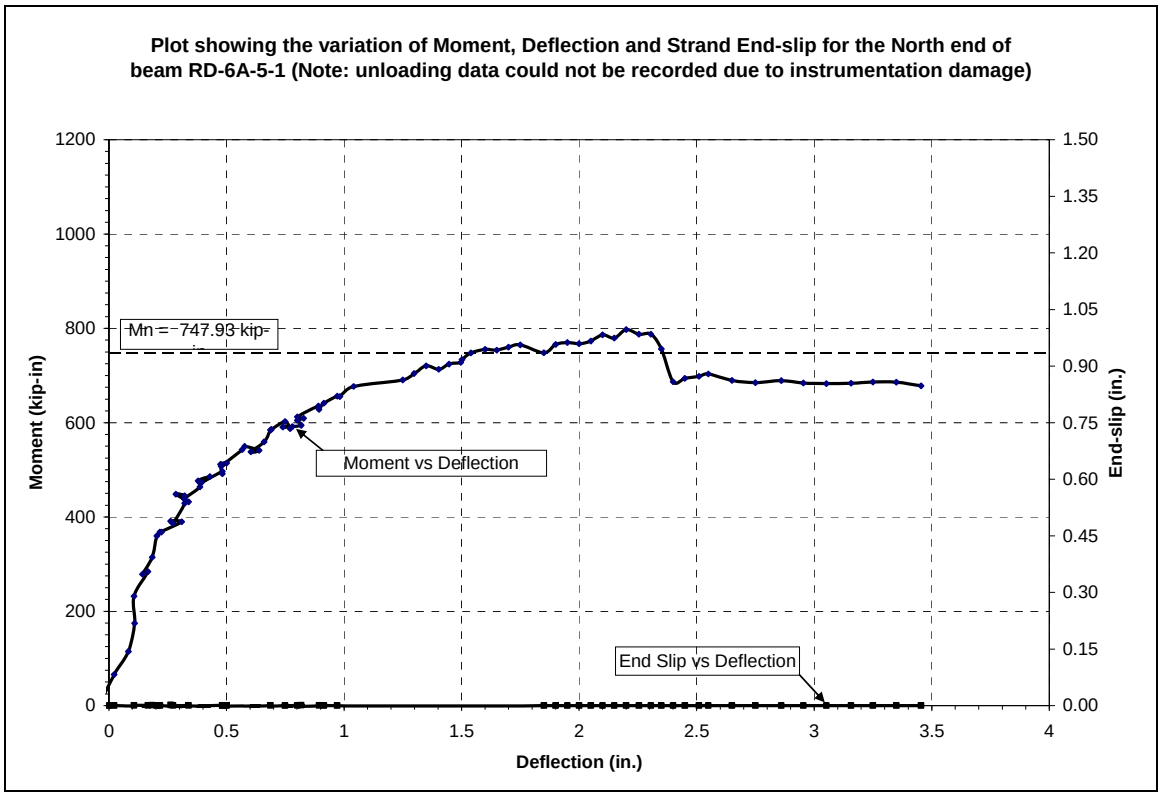
Load was applied in approximately 2.5 kips increments till first flexural cracking. Beyond this point the deflection was incremented by 0.03 in. till total deflection reached 1.00 in. Further increments of deflection were kept 0.05 in. up to 2.0 in. From this point till failure deflection increments were set to 0.1 in.

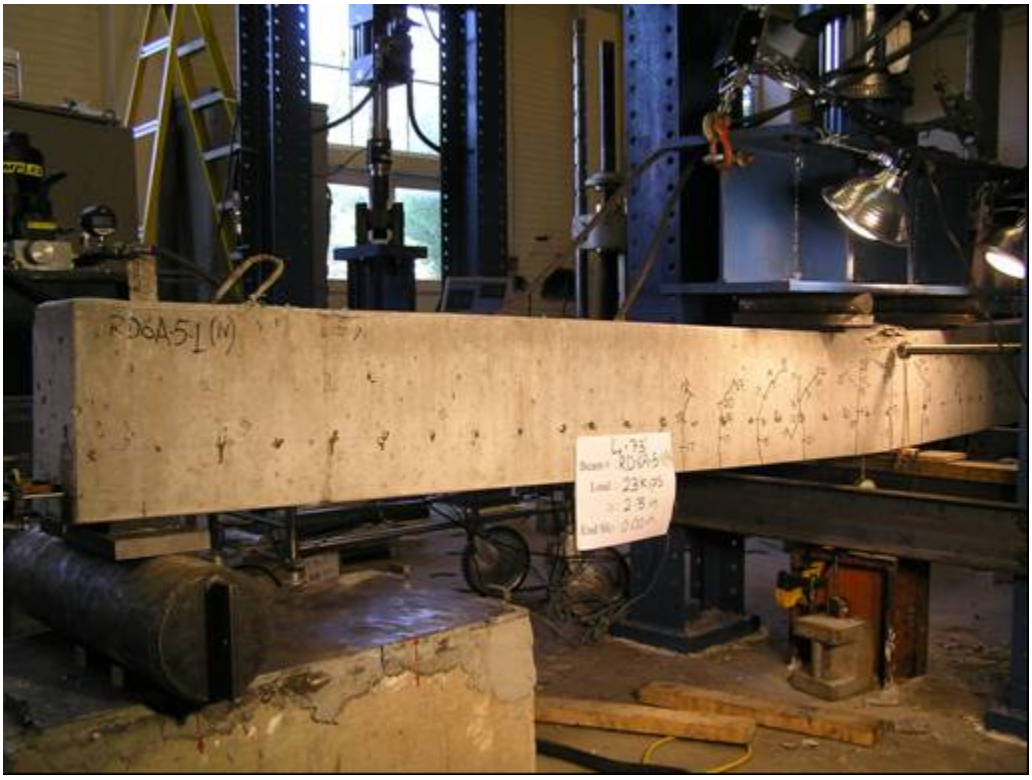
First flexural crack was observed at 10.8 kips at deflection of 0.2 in. The ext flexural cracks were observed in pairs at 13.3 kips (deflection 0.5 in.) and 13.8 kips (deflection 0.5 in.).

While the loading was in progress (at 18.5 kips, deflection 1.1 kips) the electronic readings for deflection were not consistent with the dial gauge readings. By inspection it was clear that the strain potential readings were incorrect. Graphs plotted include manually noted points beyond this load and deflection.

Concrete cracks were audible and small pieces of concrete started spalling from the concrete surface at the load of 23 kips (deflection = 2.2 in.) and finally at same load and deflection of 2.3 in. concrete crushing failure was noted at the top surface of the concrete.

End-slip readings at both ends were 0.00 throughout loading and unloading of the beam. Cracking pattern included 10 cracks in the middle 66 in span with average crack spacing of 6.6 in. First flexural crack was at 51 in from the North end.





Cracking pattern for Beam RD-6A-5-1 being loaded at North end.

BEAM NAME: RD-6A-5-1
END: SOUTH
DATE: 08/03/2005

TEST PARAMETERS	
Concrete Compressive Strength	**11420 psi**
Embedment Length(L_e)	**58 in.**
Span	**132 in.**
Failure Mode	**Flexure**
Maximum Load	**29.8 kips**
Maximum Moment	**805 kip-in**
Deflection @ Failure	**2.5 in.**
Rebound after complete unloading	**2.0 in.**
Average Transfer Length (L_t) @ release	**29.10 in.**
@ time of testing	**37.16 in.**
Average NASP P.O value for strand "D"	**6.89 kips**

TEST SUMMARY

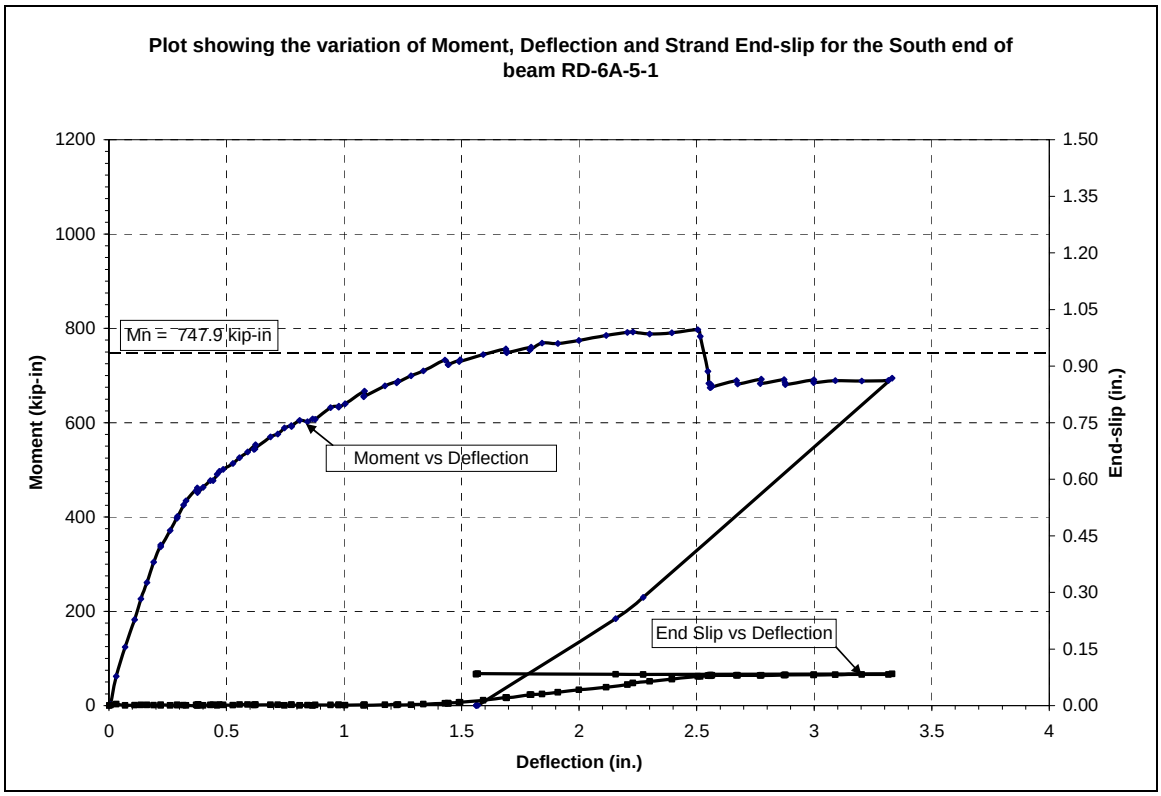
Load was applied in approximately 2 kips increments till first flexural cracking. Beyond this point the deflection was incremented by 0.03 in. till total deflection reached 1.00 in. Further increments of deflection were kept 0.05 in. up to 2.0 in. From this point till failure deflection increments were set to 0.1 in.

First flexural crack was observed at 17.0 kips at deflection of 0.4 in. First flexural cracks occurred in two pairs symmetrically about the two point loads.

Cracks became audible at the load of 26.3 kips (deflection 1.4 in.). First end-slip of 0.005 in. was noted at 26.6 kips (deflection 1.4 in.). End-slip readings went on increasing gradually from this point up to failure.

Concrete crushing failure was observed at 29.8 kips at the deflection of 2.5 in. end-slip reading at failure = 0.083 in. End-slip at the North end remained 0.000 in.

Pattern of cracks demonstrates 8 cracks in the middle 51 in. span with average spacing = 6.4 in. First flexural crack was seen at 45 in. from the South end. No inclined flexural crack was noticed. Crack width of the central crack was 3/8th in. while width of the outermost cracks = ¼ in each.



Cracking pattern for Beam RD-6A-5-1 being loaded at South end.

BEAM NAME: RD-6A-5-2
END: NORTH
DATE: 08/03/2005

TEST PARAMETERS	
Concrete Compressive Strength	**11420 psi**
Embedment Length(L_e)	**73 in.**
Span	**162 in.**
Failure Mode	**Flexure**
Maximum Load	**22.6 kips**
Maximum Moment	**780 kip-in**
Deflection @ Failure	**3.0 in.**
Rebound after complete unloading	**2.5 in.**
Average Transfer Length (L_t) @ release	**20.5 in.**
@ time of testing	**32.4 in.**
Average NASP P.O value for strand "D"	**6.89 kips**

TEST SUMMARY

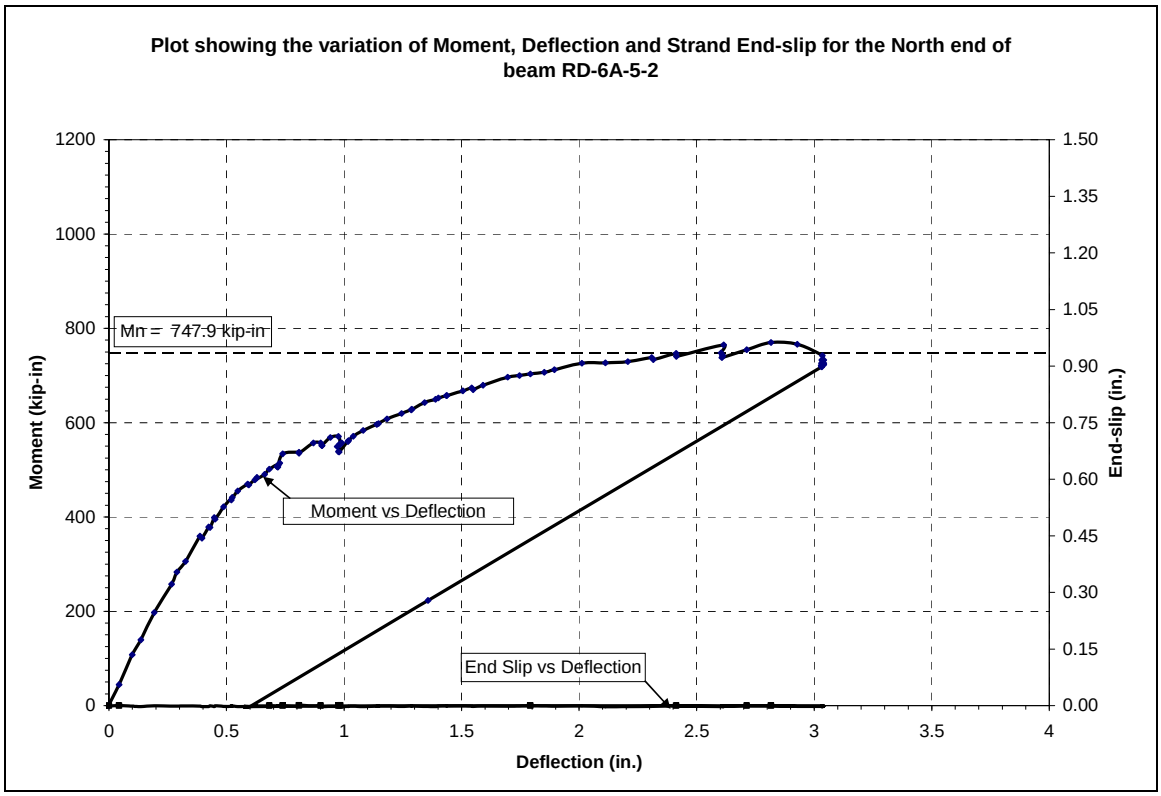
Load was applied in approximately 1.0 kip increments till first flexural cracking. Beyond this point the deflection was incremented by 0.03 in. till total deflection reached 1.00 in. Further increments of deflection were kept 0.05 in. up to 2.0 in. From this point till failure deflection increments were set to 0.1 in.

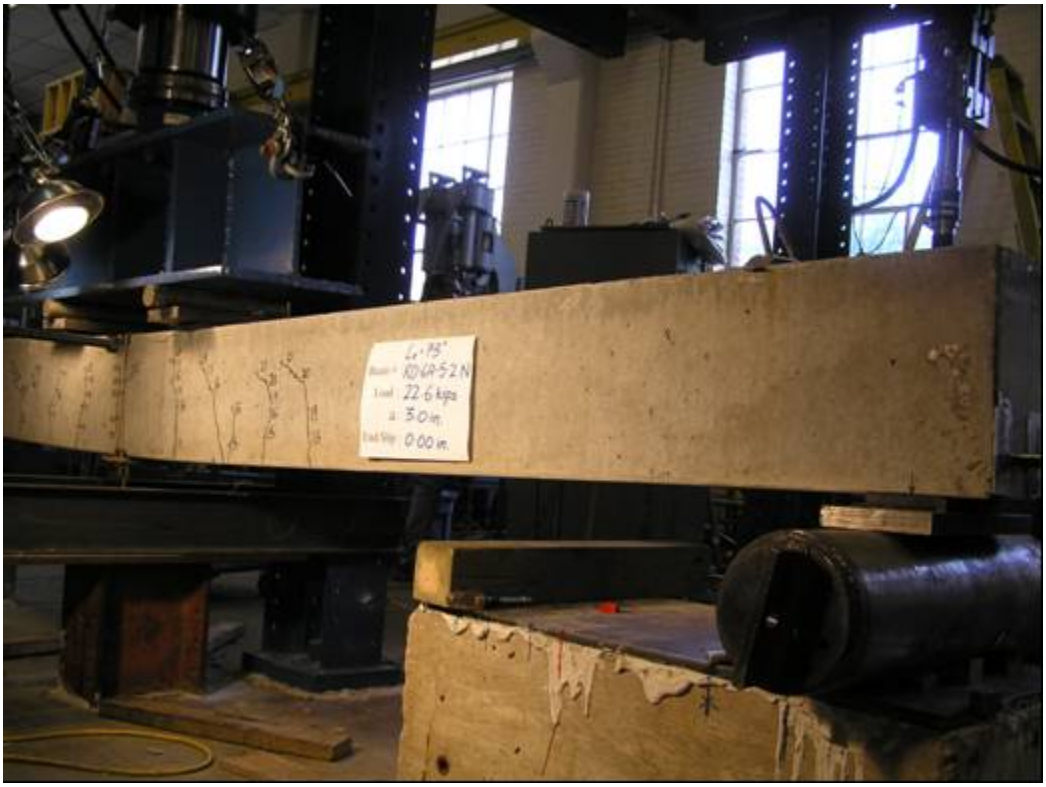
First flexural crack was observed at 11.1 kips at deflection of 0.4 in. Initially only a single crack was observed. More pronounced flexural cracks (formed in pairs and symmetrically about the two point loads) at the load of 15.0 kips. (deflection 0.7 in.)

At approximately 16.4 kips (deflection = 1.0 in.) Concrete started spalling from the earlier existing crushed zone (formed during South end testing). The value of load was slightly decreased at this point and increased again gradually hereafter.

Concrete crushing failure was noticed at the load of 22.6 kips (deflection = 3.1 in.) End-slip readings at both ends remained 0.000 in.

Cracking pattern included 8 cracks in the middle 52 in. span. No inclined flexural crack was noticed in the shear zone. First flexural crack was at Stn. 52 from the North end.





Cracking pattern for Beam RD-6A-5-2 being loaded at North end

BEAM NAME: RD-6A-5-2
END: SOUTH
DATE: 08/03/2005

TEST PARAMETERS	
Concrete Compressive Strength	**11420 psi**
Embedment Length(L_e)	**58 in.**
Span	**132 in.**
Failure Mode	**Flexure**
Maximum Load	**28.8 kips**
Maximum Moment	**778 kip-in**
Deflection @ Failure	**1.9 in.**
Rebound after complete unloading	**1.8 in.**
Average Transfer Length (L_t) @ release	**20.1 in.**
@ time of testing	**40.1 in.**
Average NASP P.O value for strand "D"	**6.89 kips**

TEST SUMMARY

Load was applied in approximately 2.5 kips increments till first flexural cracking. Beyond this point the deflection was incremented by 0.03 in. till total deflection reached 1.00 in. Further increments of deflection were kept 0.05 in. up to 2.0 in till failure.

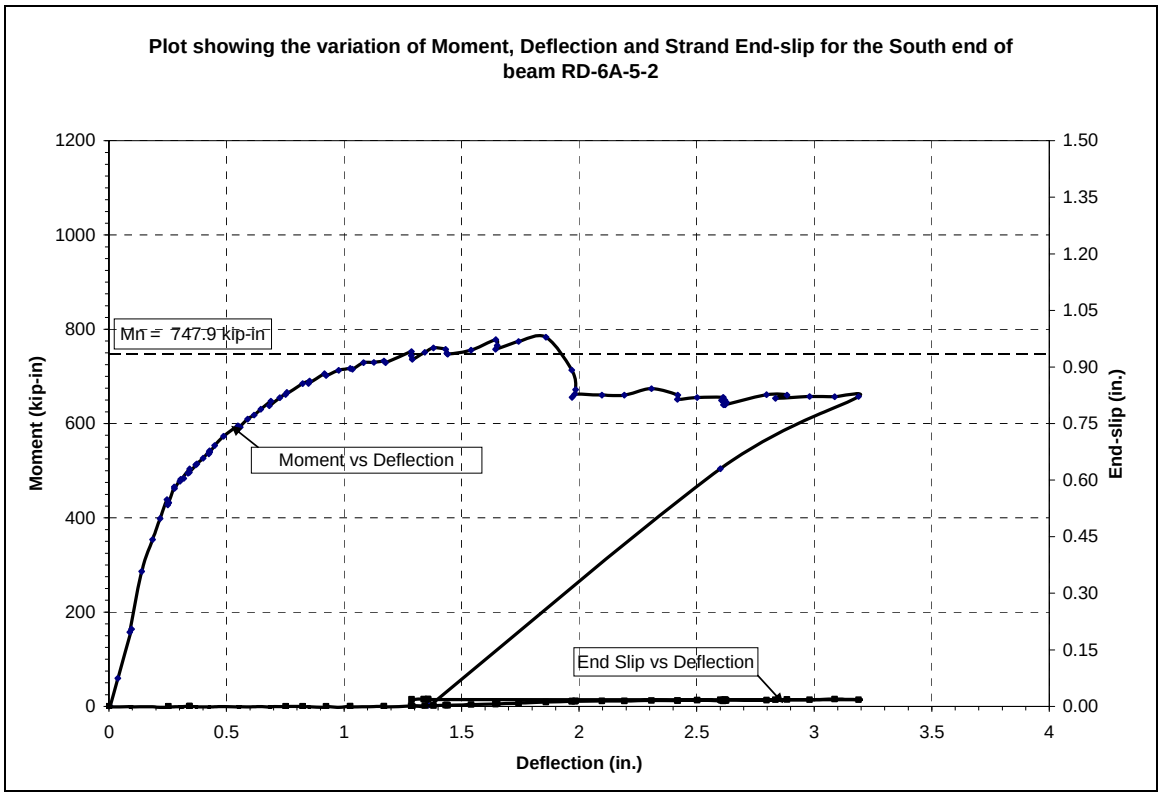
First flexural crack was observed at 16.4 kips at deflection of 0.2 in.

Cracks became audible at the load of 27.5 kips (deflection = 1.3 in.). First end-slip was noted 28 kips. (deflection = 1.5 in.). All further increments of deflection resulted in cracks producing louder and louder sound.

Finally concrete crushing failure was noticed with loud cracking noise at 28.8 kips (deflection = 1.9 in.).End-slip at failure = 0.021 in. Deflection was continued to be incremented till total deflection reached 3.0 in. and then the beam was unloaded.

Cracking pattern shows 8 cracks formed in the middle 51 in span with average crack spacing = 6.4 in. No inclined flexural crack was observed in the shear zone. First flexural crack from the South end occurred at Stn. 42.

End-slip reading at the North end remained 0.000 in. throughout the complete loading and unloading cycle.



Cracking pattern for Beam RD-6A-5-2 being loaded at South end

BEAM NAME: RD-8-5-1
END: NORTH
DATE: 07/26/2005

TEST PARAMETERS	
Concrete Compressive Strength	**13490 psi**
Embedment Length(L_e)	**73 in.**
Span	**162 in.**
Failure Mode	**Flexure**
Maximum Load	**23.5 kips**
Maximum Moment	**811 kip-in**
Maximum Deflection	**2.6 in.**
Rebound after complete unloading	**1.9 in.**
Average Transfer Length (L_t) @ release	**21.16 in.**
@ time of testing	**19.13in.**
Average NASP P.O value for stand "D"	**6.89 kips**

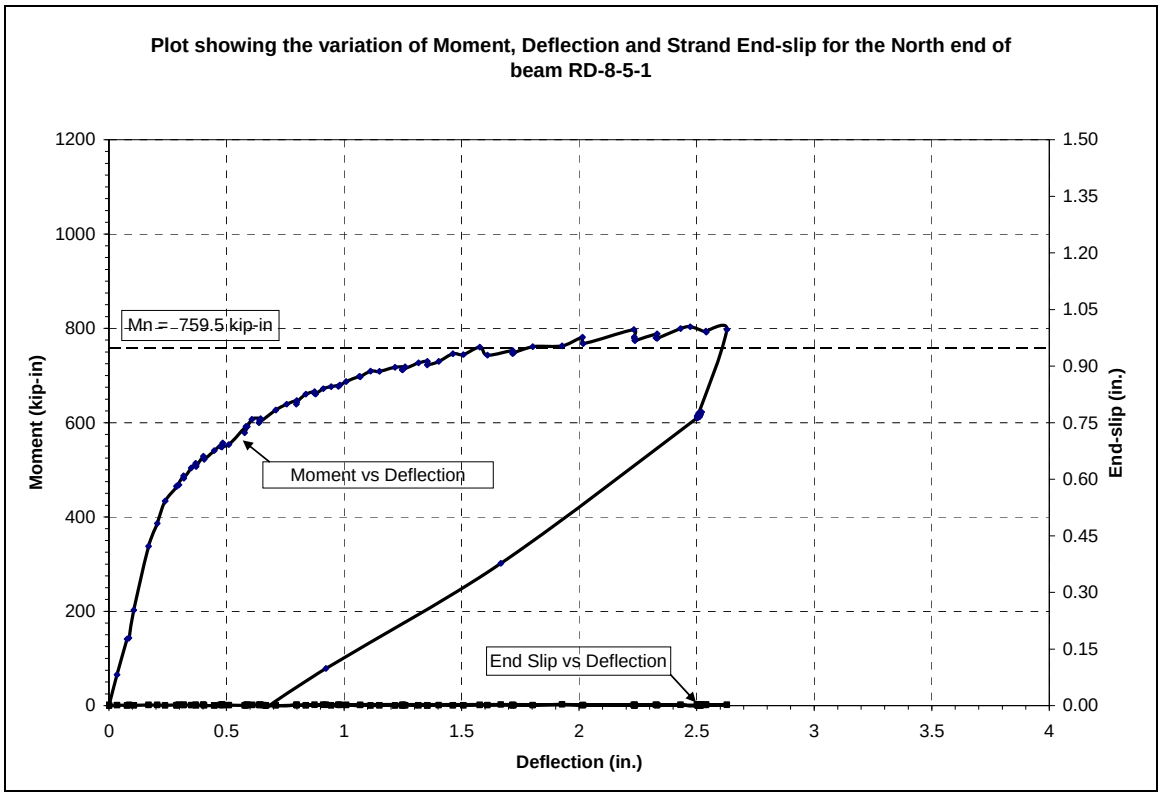
TEST SUMMARY

Load was applied in approximately 2 kips increments till first flexural cracking. Beyond this point the deflection was incremented by 0.03 in. till total deflection reached 1.00 in. Further increments of deflection were kept 0.05 in. up to 2.0 in. From this point till failure deflection increments were set to 0.1 in.

First flexural crack was observed at 12.7 kips at deflection of 0.3 in. Three cracks were seen originating from bottom surface located under two point loads and one at midway between the two point loads.

At 18.1 kips (0.6 in deflection) a pair of cracks symmetrically located from the point loads was noted and yet another pair of cracks was seen at the load of 19.2 kips (0.8 in deflection) also located in similar manner.

Cracks were audible at 22.4 kips (1.9 in deflection) and finally at 23.5 kips concrete crushing failure was noted at the top surface of the beam. Throughout the loading, the end-slip at both ends remained 0.00 in.



Cracking pattern for Beam RD-8-5-1 being loaded at North end

BEAM NAME: RD-8-5-1
END: SOUTH
DATE: 07/26/2005

TEST PARAMETERS	
Concrete Compressive Strength	**13490 psi**
Embedment Length(L_e)	**58 in.**
Span	**132 in.**
Failure Mode	**Flexure**
Maximum Load	**29.8 kips**
Maximum Moment	**804.6 kip-in**
Maximum Deflection	**2.6 in.**
Rebound after complete unloading	**could not be noted due to instrumentation damage**
Average Transfer Length (L_t) @ release	**20.15 in.**
@ time of testing	**19.41 in.**
Average NASP P.O value for stand "D"	**6.89 kips**

TEST SUMMARY

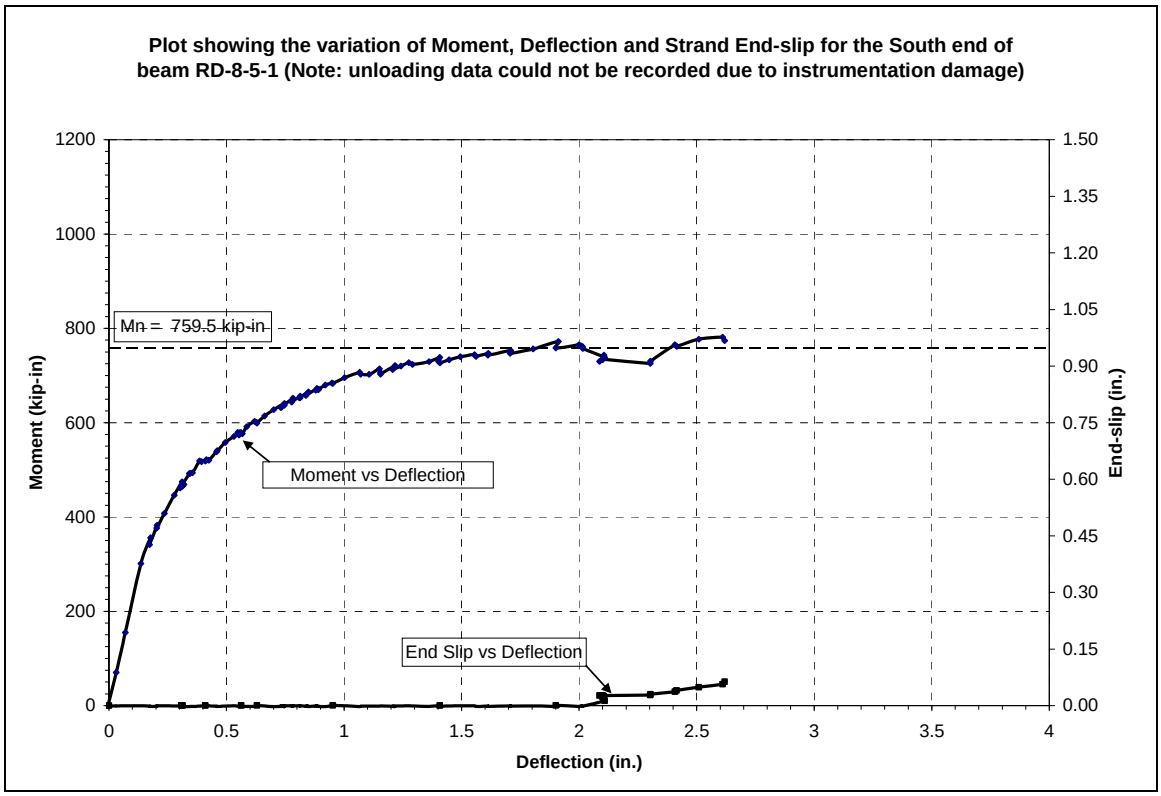
Load was applied in approximately 2 kips increments till first flexural cracking. Beyond this point the deflection was incremented by 0.03 in. till total deflection reached 1.00 in. Further increments of deflection were kept 0.05 in. up to 2.0 in. From this point till failure deflection increments were set to 0.1 in.

First flexural crack was observed at 18.2 kips at deflection of 0.3 in. first flexural cracks originated from the cracks developed during the test for North end. No cracks were seen at this stage at the south side of the two point loads.

Flexural cracks were audible at the load of 27.1 kips (1.1 in. deflection). The sound of cracks was heard without any visible changes till the load reached 29 kips (1.9 in deflection).

At 29 kips, a large inclined flexural crack was discovered, rising from Stn. 24 and Stn 21 and joining at 3 in. from bottom to form one single crack.

Loading was halted at 29.8 kips (deflection 2.6 in.) since cracking seemed to continue for a longer time at the same load. Suddenly drastic end-slip was noted at this point and approx. 5 seconds later concrete crushing was observed at the top surface. Moment at this load was 105% M_n which suggested flexural failure of the beam.



Cracking pattern for Beam RD-8-5-1 being loaded at South end

BEAM NAME: RD-10-5-1
END: NORTH
DATE: 08/01/2005

TEST PARAMETERS	
Concrete Compressive Strength	**14470 psi**
Embedment Length(L_e)	**58 in.**
Span	**132 in.**
Failure Mode	**Flexure**
Maximum Load	**30.4 kips**
Maximum Moment	**821 kip-in**
Deflection @ Failure	**2.1 in.**
Deflection @ Strand Fracture	**2.9 in.**
Rebound after complete unloading (after crushing failure)	**1.4 in.**
Average Transfer Length (L_t) @ release	**26.0 in.**
@ time of testing	**30.24 in.**
Average NASP P.O value for strand "D"	**6.89 kips**

TEST SUMMARY

Load was applied in approximately 3 kips increments till first flexural cracking. Beyond this point the deflection was incremented by 0.03 in. till total deflection reached 1.00 in. Further increments of deflection were kept 0.05 in. up to 2.0 in. From this point till failure deflection increments were set to 0.1 in.

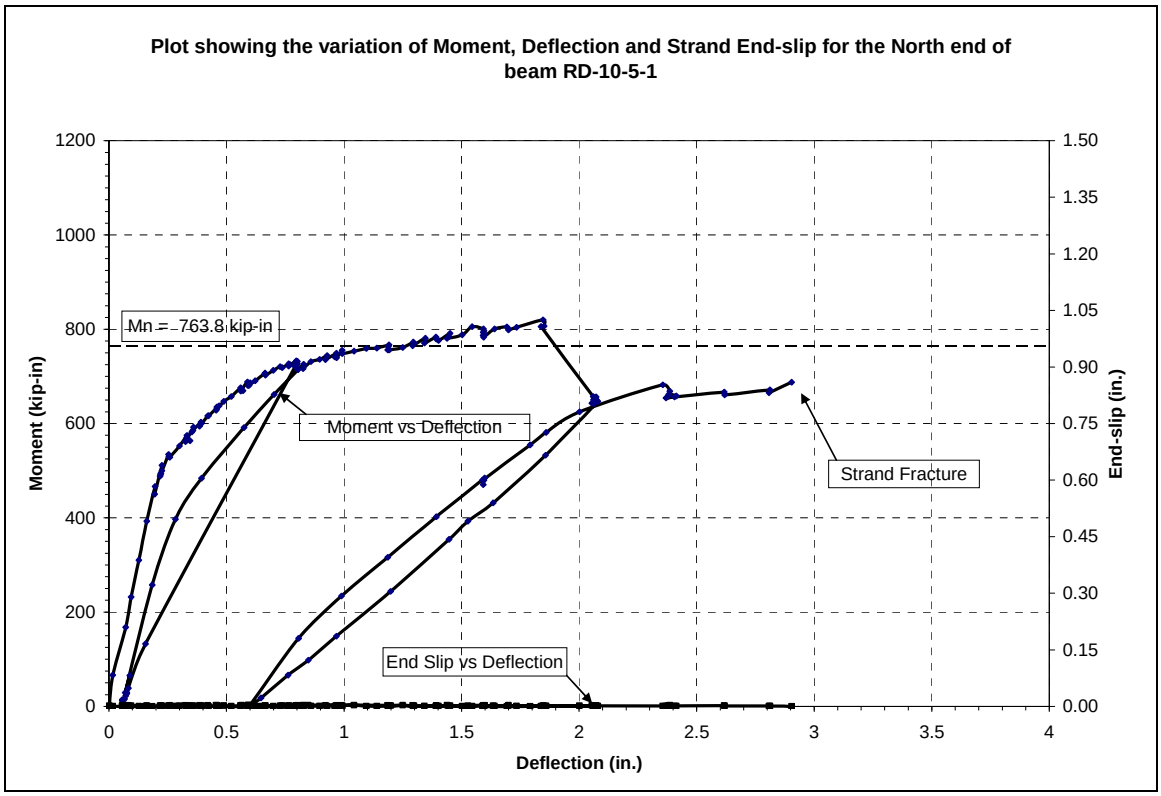
First flexural crack was observed at 19.1 kips at deflection of 0.2 in. Initially four cracks were observed located symmetrically from the center of the span.

As the load reached 21.2 kips (0.3 in deflection), another couple of symmetrically located cracks was seen. Cracks became audible at the load of 26.8 kips. The beam was unloaded at this point to re-adjust the top roller. While reloading the beam for the first time, the increments were set to 0.1 in.

At the load of 28.4 kips (deflection = 1.2 in.), a sudden flexural crack was noted at Stn. 41 Finally concrete crushing failure occurred at the load of 30.4 kips. (deflection 2.1 in.)

The beam was completely unloaded and reloaded with an aim to achieve higher deflections than at concrete crushing failure. The deflection increments for the second reloading were set to 0.2 in. Both the strands suddenly broke with a bang at approximately 2.9 in deflection. End slips at both ends remained zero for all loading cycles.

Cracking pattern demonstrated 10 cracks in the middle 58 in. of the beam span with average spacing of cracks 5.8 in.



Cracking pattern for Beam RD-10-5-1 being loaded at North end

BEAM NAME: RD-10-5-1
END: SOUTH
DATE: 08/01/2005

TEST PARAMETERS	
Concrete Compressive Strength	**14470 psi**
Embedment Length(L_e)	**46 in.**
Span	**120 in.**
Failure Mode	**Flexure**
Maximum Load	**39 kips**
Maximum Moment	**819 kip-in**
Deflection @ Failure	**2.6 in.**
Rebound after complete unloading	**1.1 in.**
Average Transfer Length (L_t) @ release	**16.85 in.**
@ time of testing	**27.1 in.**
Average NASP P.O value for strand "D"	**6.89 kips**

TEST SUMMARY

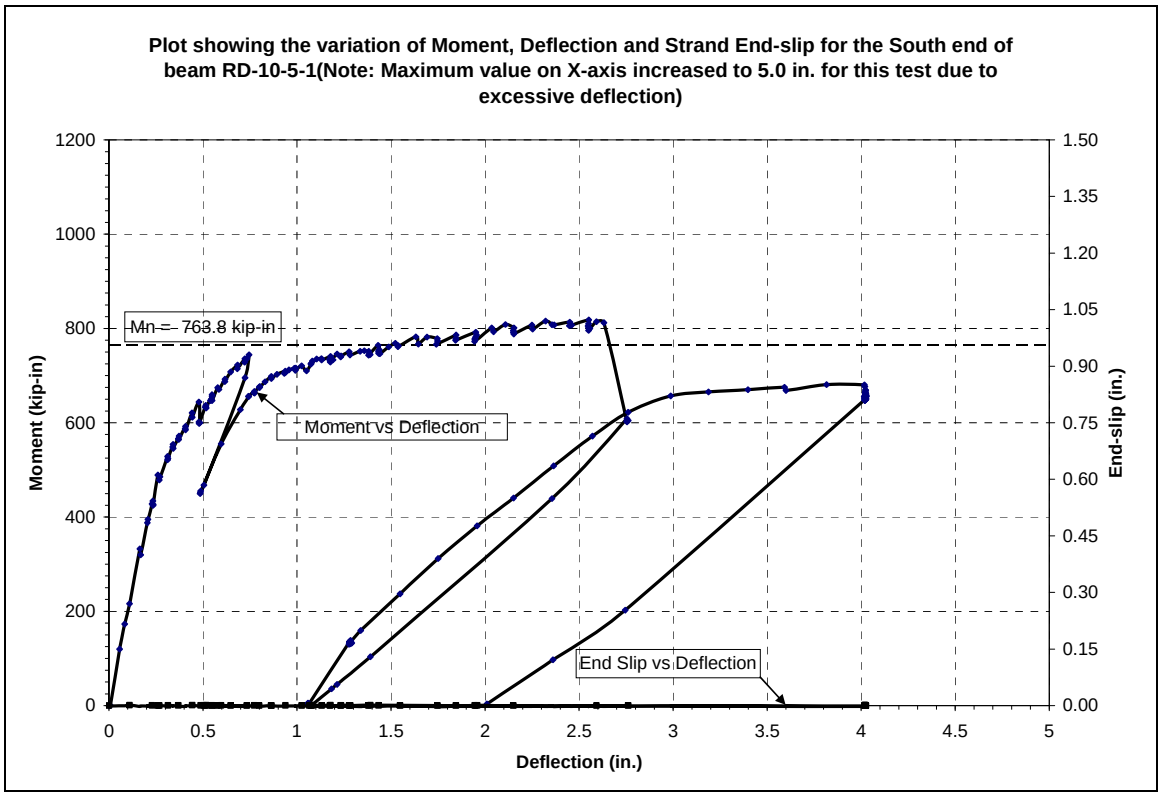
Load was applied in approximately 2.5 kips increments till first flexural cracking. Beyond this point the deflection was incremented by 0.03 in. till total deflection reached 1.00 in. Further increments of deflection were kept 0.05 in. up to 2.0 in. From this point till failure deflection increments were set to 0.1 in.

First cracks to be observed for this loading originated from the earlier cracks present on the beam due to the North end testing. New Flexural cracks were observed at 25.7 kips at deflection of 0.3 in. Initially three cracks were noted at two point loads and at approximately midpoint of the two load points.

An inclined flexural crack was noticed with a sudden sound at 25 in from the north support at the load of 30.4 kips. (Deflection = 0.5 in.). At 31.4 kips, the secondary cracks originating from the existing cracks at the north side reached the bottom surface forming another inclined flexural crack at 8 in. from north support.

Concrete spalling began with extended cracking sound at 38.4 kips (deflection 2.3 in.) and suddenly at 39 kips concrete crushing was observed. The load was completely removed and re-applied with an aim of achieving greater deflection. There were no noticeable changes during the second loading cycle. The inclined flexural cracks appear to widen with increasing deflection.

Cracking pattern demonstrated 7 cracks in the middle 48 in. In addition to these flexural cracks, 2 inclined flexural cracks (@ Stn. 8 and Stn. 26) were observed in the shear zone at the North side.


Plot showing the variation of Moment, Deflection and Strand End-slip for the South end of beam RD-10-5-1(Note: Maximum value on X-axis increased to 5.0 in. for this test due to excessive deflection)
Mn = 763.8 kip-in
Moment vs Deflection
End Slip vs Deflection
Moment (kip-in)
End-slip (in.)
Deflection (in.)
0
200
400
600
800
1000
1200
0.00
0.15
0.30
0.45
0.60
0.75
0.90
1.05
1.20
1.35
1.50
0
0.5
1
1.5
2
2.5
3
3.5
4
4.5
5


Beam #
Load
End Slip

Cracking pattern for Beam RD-10-5-1 being loaded at South endBEAM NAME: RD-10-5-2
END: NORTH
DATE: 08/02/2005

TEST PARAMETERS	
Concrete Compressive Strength	**144701 psi**
Embedment Length(L_e)	**58 in.**
Span	**132 in.**
Failure Mode	**Flexure**
Maximum Load	**29.2 kips**
Maximum Moment	**788.4 kip-in**
Deflection @ Failure	**1.9 in.**
Rebound after complete unloading	**1.6 in.**
Average Transfer Length (L_t) @ release	**14.85 in.**
@ time of testing	**22.0 in.**
Average NASP P.O value for strand "D"	**6.89 kips**

TEST SUMMARY

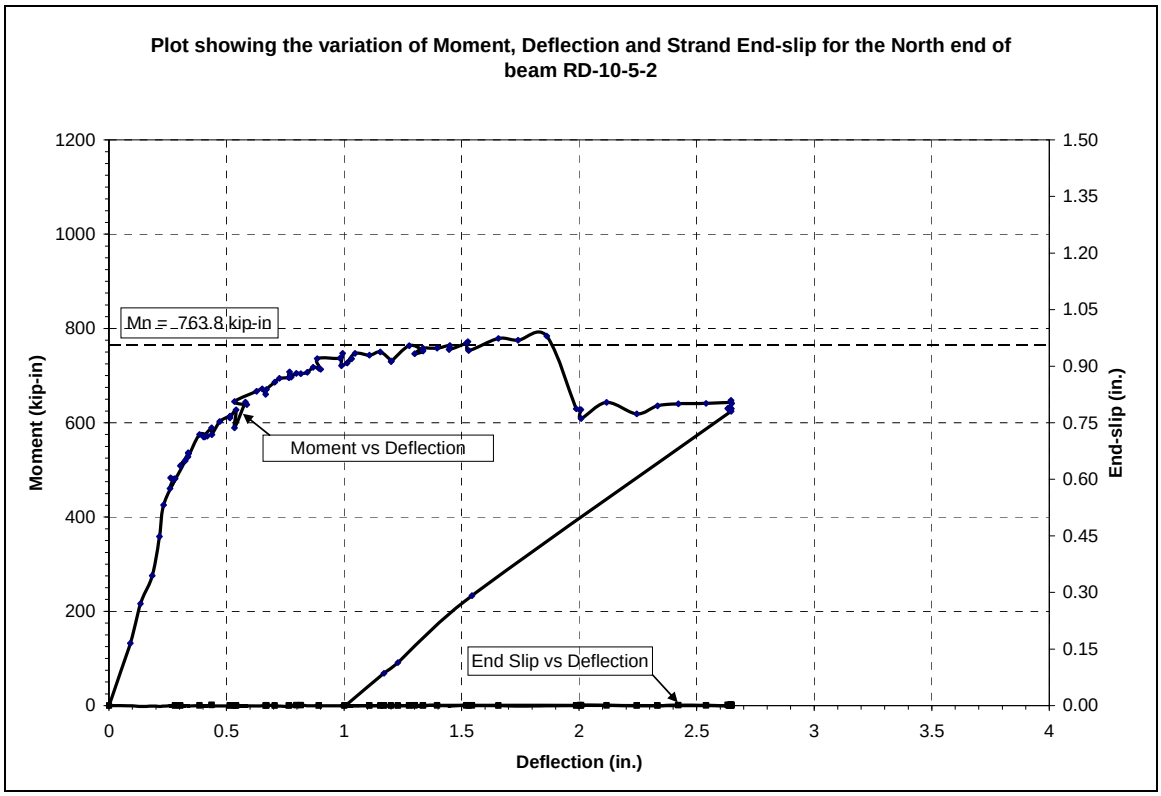
Load was applied in approximately 3 kips increments till first flexural cracking. Beyond this point the deflection was incremented by 0.03 in. till total deflection reached 1.00 in. Further increments of deflection were kept 0.05 in. up to failure.

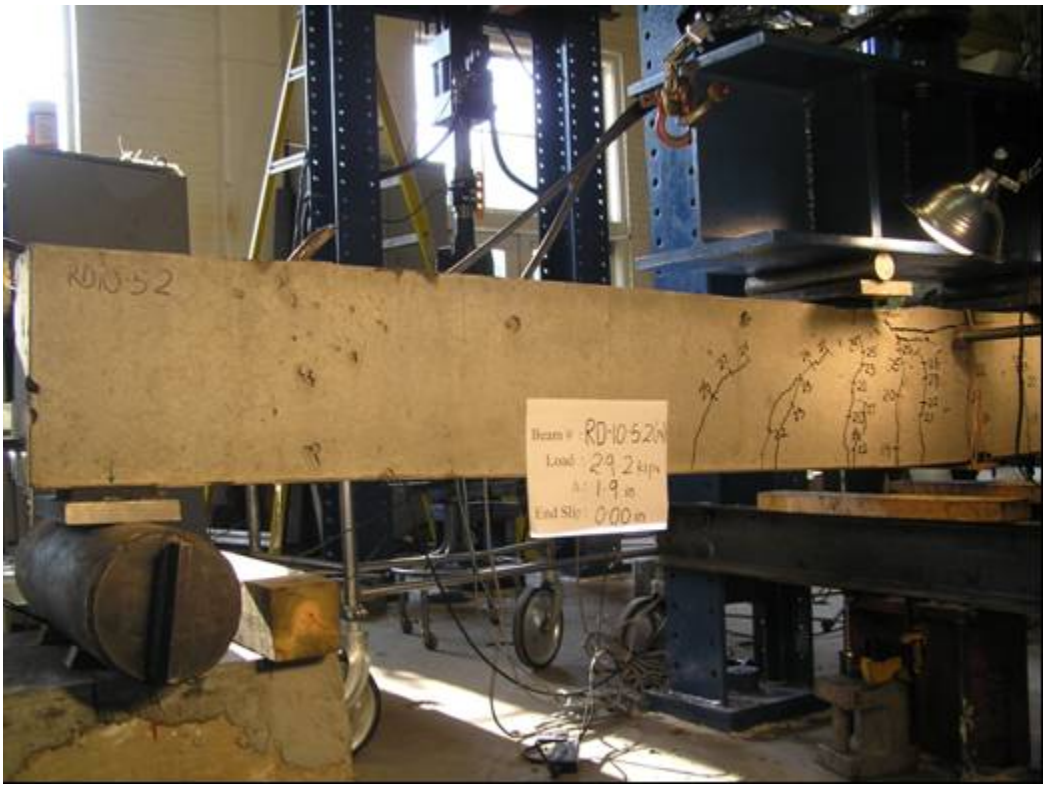
First flexural crack was observed at 18.6 kips at deflection of 0.2 in. At this load a pair of cracks was seen between the two point loads, the next pair of cracks was observed at load of 20 kips (deflection 0.3 in.)

Cracks became audible at 27.5 kips (deflection = 1.1 in.) The sound became louder and more extended in time at 29.2 kips, waiting for two minutes at the same load and deflection of 1.9 in. resulted in sudden concrete crushing failure at the top surface.

Loading was continued further to achieve higher deflection and finally stopped at deflection = 2.5 in and the beam was unloaded. End slips at both ends remained 0.00 in throughout the loading and unloading cycles.

Crack observed crack pattern included 9 cracks in the middle 53 in span with average spacing of cracks = 5.9 in. No inclined flexural cracks were noted.





Cracking pattern for Beam RD-10-5-2 being loaded at North end

BEAM NAME: RD-10-5-2
END: SOUTH
DATE: 08/02/2005

TEST PARAMETERS	
Concrete Compressive Strength	**14470 ksi**
Embedment Length(L_e)	**46 in.**
Span	**120 in.**
Failure Mode	**Flexure**
Maximum Load	**37.8 kips**
Maximum Moment	**794 kip-in**
Deflection @ Failure	**1.9 in.**
Rebound after complete unloading	**1.6 in.**
Average Transfer Length (L_t) @ release	**18.23 in.**
@ time of testing	**22.03 in.**
Average NASP P.O value for strand "D"	**6.89 kips**

TEST SUMMARY

Load was applied in approximately 4 kips increments till first flexural cracking. Beyond this point the deflection was incremented by 0.03 in. till total deflection reached 1.00 in. Further increments of deflection were kept 0.05 in. till failure and beyond failure it was set to 0.1 in.

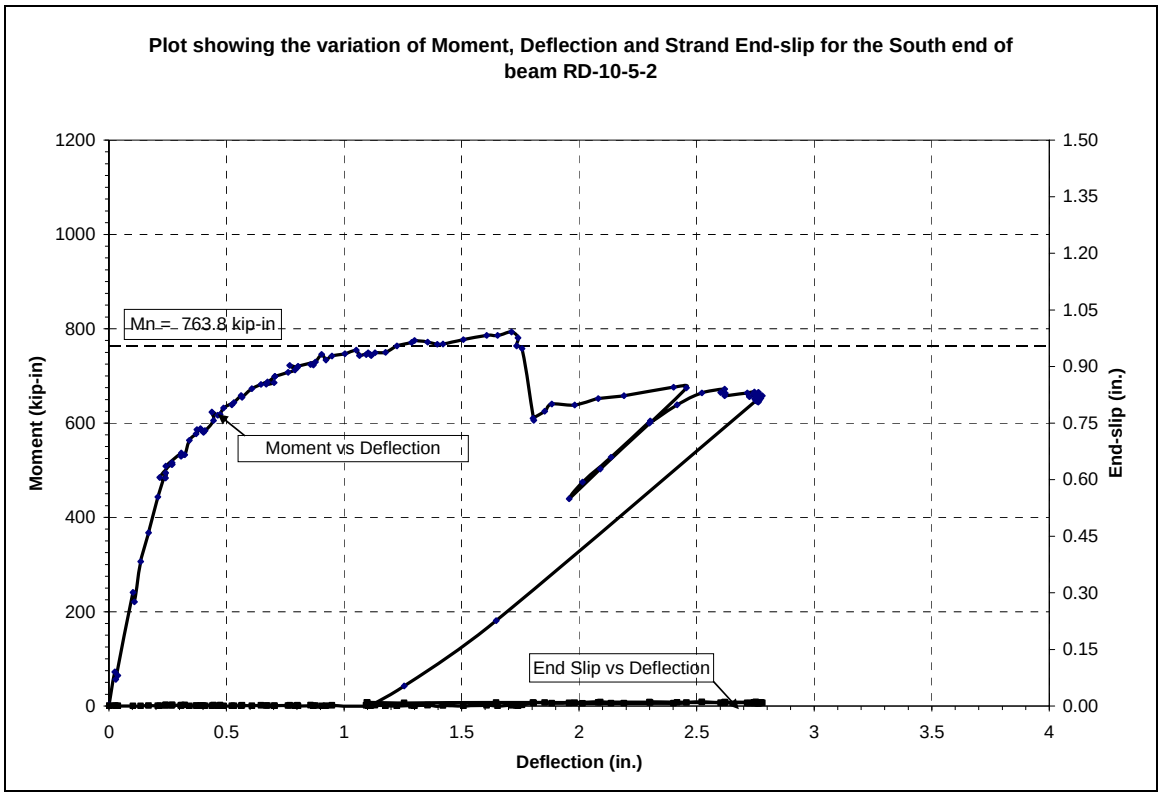
First flexural crack was observed at 24.1 kips at deflection of 0.2 in. Up to load of 25 kips (deflection 0.3 in.) four cracks were noted symmetrically about the two load points and one more flexural crack was noticed at approximately midpoint of the two point loads. at 26 kips. (deflection 0.3 in.)

Cracks became audible from the load of 36.5 kips (deflection 1.5 in.) up to concrete crushing failure which was observed at 37.8 kips. (deflection 1.9 in.) At this point end-slip of 0.013 in was noted at the South end while at North end it was noted as 0.001 in. Both these end-slip readings stayed constant for further loading and unloading cycles.

While applying further load, at approximately 2.3 in deflection, the beam was noticed to be touching the wooden block kept to prevent damage to strain-potentials. Load was reduced by a small amount to remove the wooden block.

Finally loading was stopped at a deflection of 2.6 in. and the beam was unloaded completely.

Cracking pattern included 9 cracks in the middle 58 in. span. No inclined flexural cracks were seen in the shear zone. Width of the central crack was 3/8th in. Location of the first flexural crack from the South end was 37 in.



Cracking pattern for Beam RD-10-5-2 being loaded at South end