CHAPTER II

The Construction of Teal Bridge

When the 2d Engineer Construction Group received the directive to go ahead with construction of Teal bridge, the job was assigned to the 84th Engineer Construction Battalion, a unit which has come to be known as "The Conquerors of the Imjin." Lieutenant Colonel James R. O'Grady, commanding officer of the battalion, appointed Captain A[rlton] W. Hardin, his Assistant S-3, as project officer and designated Company B, commanded by Captain Edward H. Goldsmith, to do the construction.

Pile penetration tests were made with open-end Armco piles, pointed Armco piles, and 12-inch I-beams. Using a 5,000-pound hammer with 160 blows per minute, it was possible to drive the I-beams to a depth of a little over 18 feet, the pointed piles to a depth of 22 feet, and the open-end piles to a depth of 27 feet and to bedrock. An attempt was made to pull up an open-end pile with two D–8 hyster winches in order to inspect it for splitting or other damages, but it was impossible to extract it.

The first preparatory work was begun on 2 October 1952 when Company B began construction of a causeway from the south shore out to the site of pier 11. The piers were numbered 1 to 16 from south to north. On 10 October the excavation of the approach on the north shore was begun. When the approximate grade level of the approach road was reached, two springs which put out water at the rate of about 350 gallons per minute were uncovered. To correct this situation it was necessary to excavate six feet below the grade level, dig a V-shaped trench with the apex of the "V" at the springs and the points at either side of the abutment, and fill it with rock to make a French drain to carry off the water. By the time the north approach was finished, some 14,800 cubic yards of earth had been excavated; some of this earth was pushed out to make the causeway on the north side of the river and later caused some difficulty in the use of heavy equipment when it became boggy.[1]

The first of the 128 piles in the bridge was driven on the 16th of October as the beginning of pier 11.[2] Considerable difficulty in driving the piles was encountered due to the presence of large boulders in the riverbed; piles were observed to "walk" as much as eight inches to the side while being driven vertically. This caused a problem when it was time to cap the piers with the 12-inch H-beams, as the piles were out of line. This misalignment was corrected by pulling the piles back into line as much as possible with a tractor and block and tackle. Colonel O'Grady allowed a maximum sideways pull of 2.5 inches on the piles, due to the danger of bending or snapping the pile.[3] (*Figures* 20 *and* 21)

On 20 October work was begun on the south approach; the riverbank on this side was of volcanic rock which was cracked and fissured. The fissures were filled with clay, a condition which made blasting the rock out very difficult. A set of charges would loosen the rock and open up the fissures, but, when a bulldozer tried to push out the rock, the fissures would close up so that the clay again bound the rock in place.[4] Water, from springs and occasional thaws, also added complications to drilling holes for charges as, in the extreme cold, bits and drills would actually freeze tight in the holes. In all, 14,200 pounds of dynamite were used to blast out 12,320 cubic yards of rock.[5]

Colonel O'Grady recommended to the 2d Engineer Construction Group that diagonal bracing be added to the pier design to strengthen the bridge against overturning. *(Figure 22)* This consisted of a diagonal brace of 12-inch channel iron, running from the top of each pile to the bottom of the next downstream pile, bolted and welded in place. The four piles in each of the two rows in the pier were connected seven feet down from the bottom of the H-beam cap (approximately at causeway level) with 12-inch channel iron bolted in place, and the lower ends of the diagonal brace were welded to this. The purpose of this bracing was to transmit the shock of debris and pressure of the water from the top of each pile to the bottom of the next downstream pile, thus actually exerting downward pressure rather than horizontal pressure which might overturn the pier. This recommendation was accepted, and this feature was added to the bridge design.[6]

Despite cold weather and high winds, welding continued on the capping and bracing of the piers already driven. Cold, and the bulky clothing it made mandatory, made welders clumsy as they climbed around on the piers. High winds made it very hard to

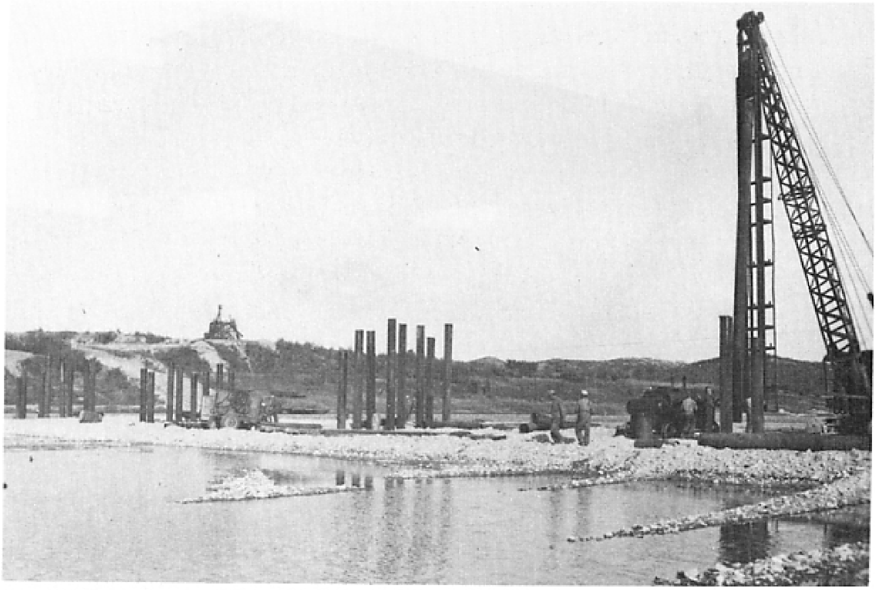


Figure 20. Engineers driving 16-inch Armco steel–column piles for the low-level Teal bridge in October 1952.

Figure 21. Cables used to align piles that had "walked" when driven against large boulders in the riverbed.

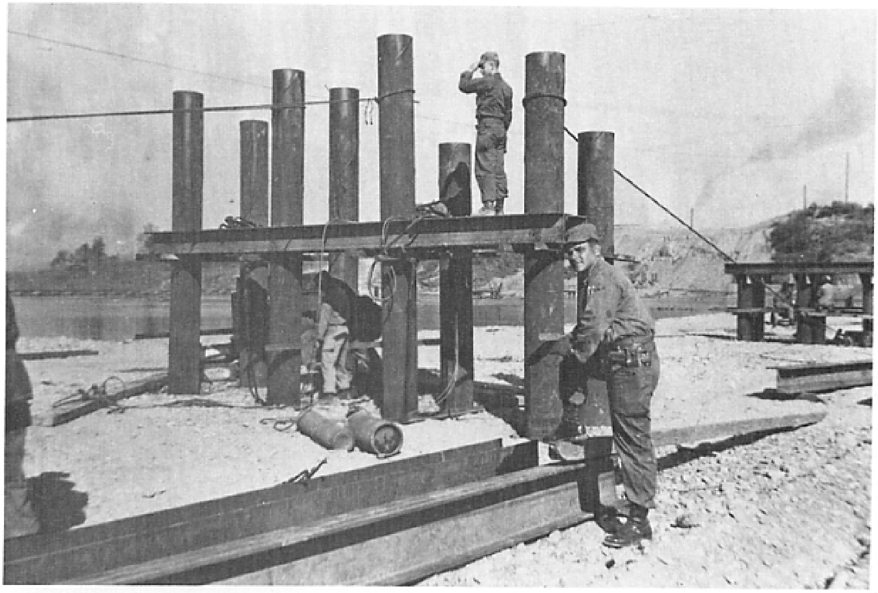


Figure 22. A nearly completed pier featuring diagonal channel-iron bracing.

Figure 23. Troops constructing blackout shelters for night welding that could double as curing cabins in cold weather.

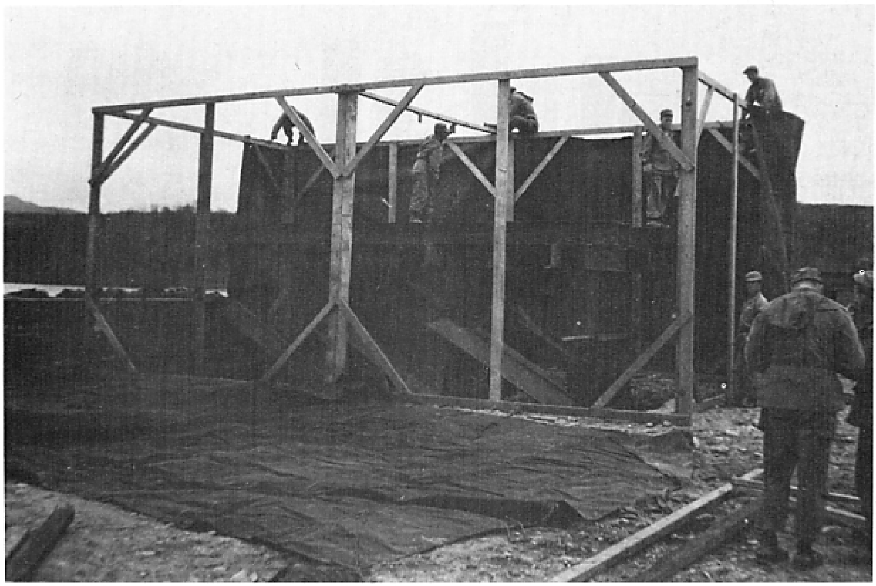


Figure 24. Troops filling the hollow Armco piles with concrete, with 36-inch I-beam girders in the foreground.

Figure 25. Anchor bolts set in a concrete-filled pile capped by 12-inch H-beams.

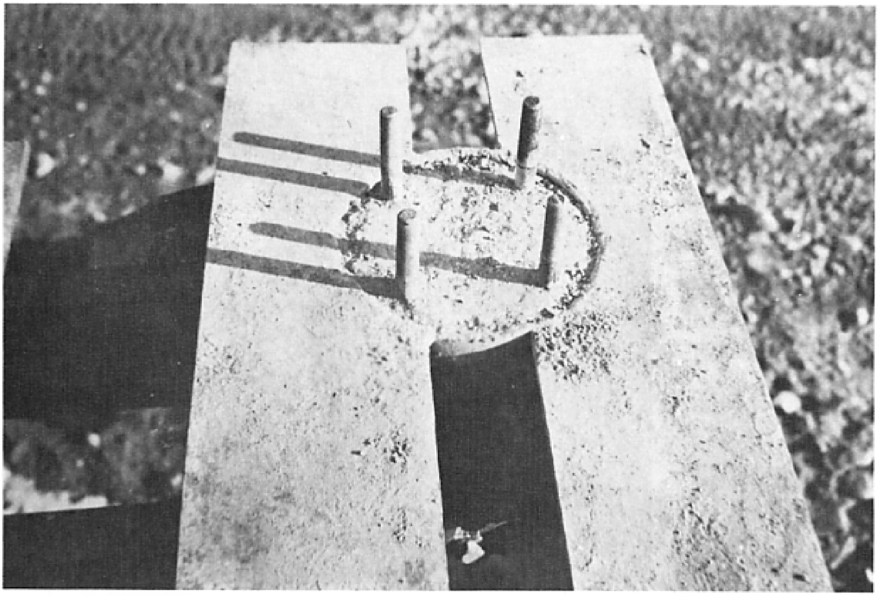


Figure 26. Teal site on 26 November 1952 showing completed piers at south end of bridge, left, and others still under shelters. I-beam girders and the Imjin River flowing north of the causeway are visible at right.

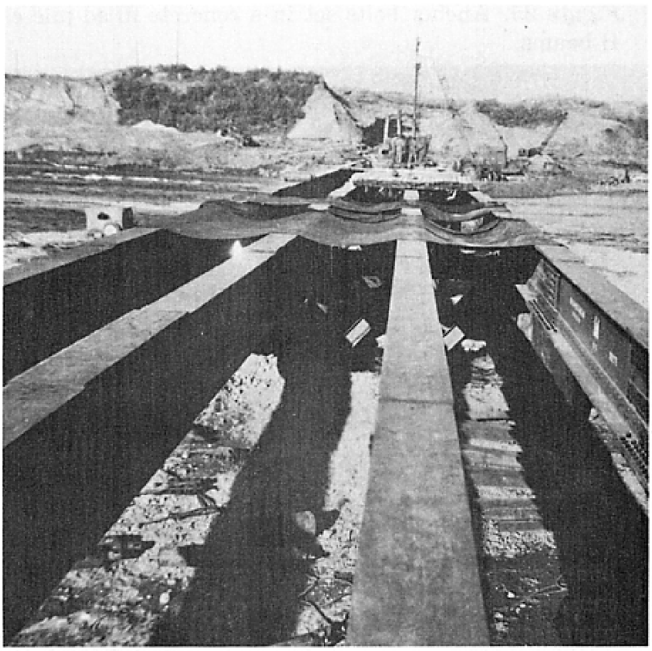


Figure 27. Thirty-six-inch I-beams in place on bridge with a pile driver, in background, working on one of the northernmost piers.

Figure 28. Side view of girders in place. Crew on right is placing decking.

Figure 29. Troops placing decking from pier 16 to the north abutment. This was the only span which used six 24-inch girders. Note angle-iron diaphragming between girders. Visible at center is two-inch by six-inch laminated sub-decking and beyond that is three-inch by twelve-inch diagonal decking.

Figure 30. Girders in place on piers 8 through 11 allowing the passage of water below these spans and the construction of a causeway to pier 11 from the north bank.

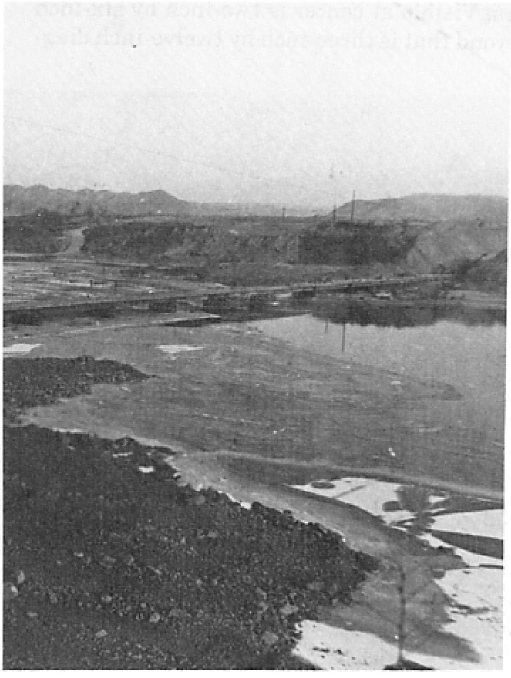


Figure 31. Teal bridge from the south shore on 7 January 1953 as troops place decking on the north end.

Figure 32. Teal bridge from the north shore on 16 January 1953 when almost completed. This view shows the removable guardrail.

Figure 33. Army vehicles crossing the completed Teal low-level bridge at the end of January 1953.

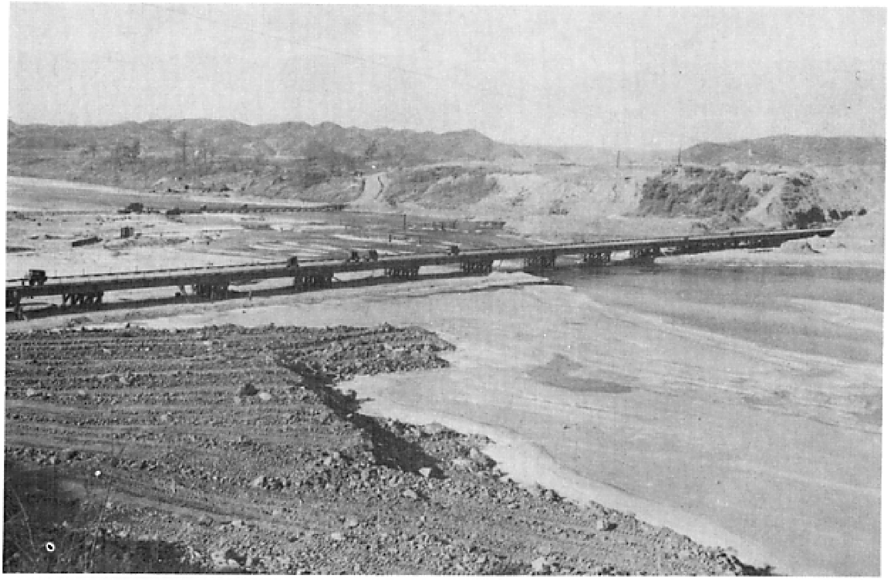
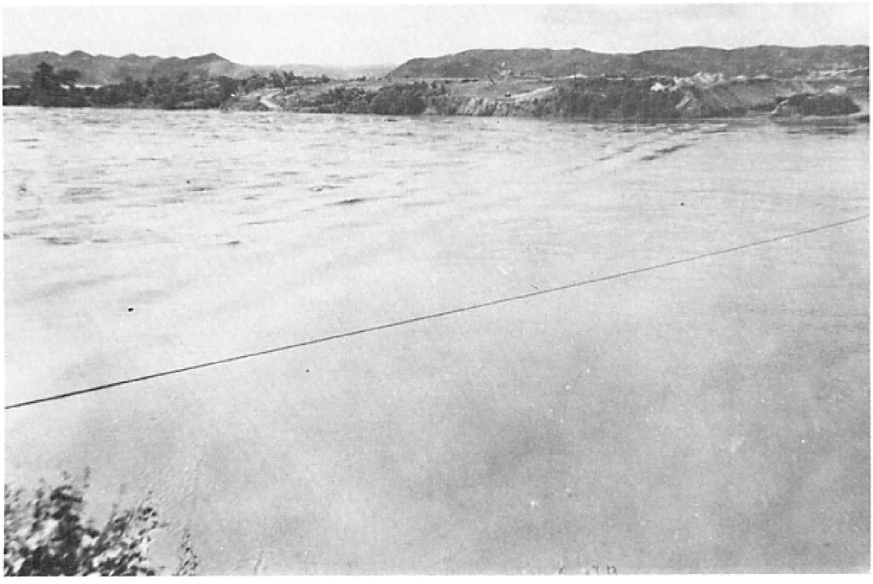


Figure 34. Teal bridge underwater on 15 July 1953, viewed from the south approach road.

Figure 35. The Imjin River flowing 12 feet over the Teal bridge on 15 July 1953.



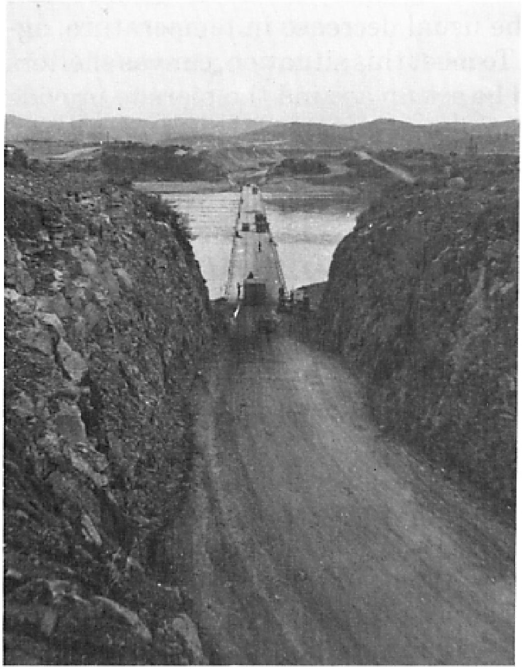
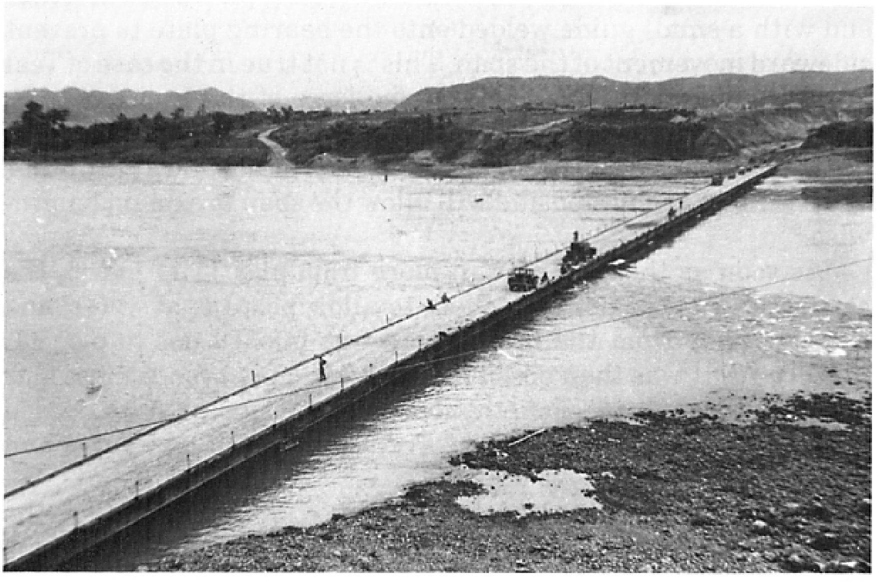


Figure 36. Teal bridge in operation on the afternoon of 16 July 1953 after floodwater receded.

Figure 37. Teal bridge after the flood of 15 July 1953 showing the damage to the removable guardrail, which was not removed due to the rapid rise of the river.



keep an arc. Nighttime, with the necessity for working in as much blackout as possible and the usual decrease in temperature, aggravated these difficulties. To meet this situation, canvas shelters were designed which could be set up around the piers to provide both shelter from the cold and wind and blackout at night. The frames of these shelters were so constructed that they could be taken down and moved as required.[7] *(Figure 23)*

On *20* November the welding on pier 11 was completed, and concrete was poured into the piles. *(Figures 24 and 25)* The canvas shelters were put to a new use at this time, as it was necessary to provide heat to keep the concrete in the piles from freezing before it cured. *(Figure 26)* A shelter was set up around the pier, and a hot-air blower maintained a suitable temperature, about 60°, until the concrete was cured.[8]

On 29 November, when the tops of the piles were sealed with asphalt and the bearing plates set in place, the first girders were lifted into place in span 11 with cranes. The I-beams used as girders were of three different types: ten spans were made up of four 36-inch, rolled-steel I-beams; six spans were of four 36-inch, built-up (bolted splices) steel I-beams; and the remaining span, from pier 16 to the north abutment, was made up of six 24-inch, rolled-steel beams. *(Figures 27, 28, and 29)* The first two types were salvaged from the old Teal bridge.

In normal bridge construction, to allow for expansion, spans are fixed at one end and rest free on bearing plates at the other end with a small guide welded onto the bearing plate to prevent sideward movement of the span. This is not true in the case of Teal bridge, which will have to resist the force of the Imjin's floods. Both ends of each span are bolted in place; however, at one end of the span the holes for the anchor bolts are round, and at the other end the holes are slotted and will allow the span to expand lengthwise.[9]

As soon as the steel was in place from pier 11 to pier 9, the causeway was cut between them to allow passage of water, and the causeway from the north shore was pushed out to pier 11. *(Figure 30)* It was then possible to drive the piles for the last four piers (12 through 16). Penetration, to bedrock on all piles, varied from 15 feet to 32 feet, 8 inches; average penetration was around 27 feet.[10]

It was planned to excavate all the way to bedrock for the abutments so that concrete could be poured directly on bedrock, but seepage of water into the excavation made this impracticable. A key to bedrock was achieved by driving four 12-inch H-beam piles to bedrock in the excavation, capping these with another H-beam, and pouring the concrete abutment around these capped piles.[11]

On 11 December the two-by-six-inch laminated wood sub-decking was started at pier 11 and worked to the south shore; on 22 December the diagonal three-by-twelve-inch decking was started and nailed down to the sub-decking at a 45° angle to the center line. (See *Figure 29.*) The decking had an overall width of 22 feet, which, with six-inch curbing on either side, left a 21-foot running surface for vehicles.

By 10 January, the decking, curbing, and guardrail were in place on all of the bridge except span number one, which had to await the completion of the south abutment. The guardrail on Teal consisted of half-inch wire rope strung through pipe posts which were set in sockets bolted to the outside of the curbing.[12] *(Figure 32)* The guardrail was so designed that it could be removed quickly before floods topped the bridge, thereby allowing freer flow of water and debris over the bridge.

All construction work on the bridge was completed by 27 January, and it was pressed into service prior to the official opening, because the division occupying that sector of the front was being relieved and the bridge was needed.[13] *(Figure 33)* The official opening and dedication of Teal bridge took place on 31 January 1953, when Major General M. M. A-R-West, Commander of the Commonwealth Division, cut the engineer tape at the south end of the bridge.

Teal got its first baptism and trial in the flash flood of 15 and 16 July 1953. The water covered the bridge during the early hours of 15 July, and at the crest of the flood Teal was under 12 feet of running water. The guardrail was not removed as planned because of the speed of the river's rise and the danger of working on the wet structure, which might be overtopped at any moment in the darkness. The flood receded on 16 July, and by 3 PM Teal was free of water and in service again; the only damage was to the removable guardrail.[14] *(Figures 34-37)*