Abstract

The Development of Confederate Ship Construction: An Archaeological and Historical Investigation of Confederate Ironclads *Neuse* and *Jackson*

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Southern shipbuilding in 1861 was comparable to construction throughout the United States. Confederate ships early in the war show continuity of these traditions, but beginning in 1862, wartime stimuli created a distinct Confederate shipbuilding style. This thesis examines changes in the Confederacy's conceptual approach to construction by tracing pre-war shipbuilding traditions and popular trends in naval architecture.

As a consequence of shipbuilders' conservative nature, ships' structural systems and assembly order change gradually, allowing traditions to be traced. A decentralized shipbuilding program led to high levels of variability between Confederate ships, even among vessels of the same class. Local shipbuilders used vernacular methods to expedite construction. Historical and archaeological examination of the CSS *Neuse* and *Jackson*, two diamond hull ironclads today housed in museums, identified the progression of Confederate shipbuilding and the non-traditional features in their construction.

The Development of Confederate Ship Construction:

An Archaeological and Historical Investigation of Confederate Ironclads *Neuse* and *Jackson*

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CHAPTER 1: INTRODUCTION

The American Civil War is considered the first modern war, introducing a number of influential technologies developed during the Industrial Revolution on a large scale for the first time (Hagerman 1988:xi). These technological developments included rifled guns, shells, armor plating, and steam engines. From 1861 to 1865, new technologies had devastating effects on land. Single battles, such as Gettysburg, generated more causalities than all previous American wars combined (Barnett 2006:27). New maritime technology triggered extensive change as well, affecting naval architecture, ship construction, and naval tactics. Heavy losses on land were contrasted by conservatism and indecision at sea.

The Industrial Revolution produced technological, economic, and social change. Virgil eloquently described the basis for these structures in previous centuries by stating, "*Arma virumque cano*", or "I sing of arms and the man" (Virgil 1917:1). While force of arms provided the basis for power since antiquity, the Industrial Revolution rendered martial strength less important than industrial capability. Civil War contemporary Karl Marx identified industry as the combination of knowledge, tools, and labor (Beamish 1992:106). Southern naval strategy attempted to utilize the latest knowledge, tools, and labor in naval architecture to thwart the United States Navy.

Nineteenth Century Changes in Naval Technology

The Industrial Revolution altered naval warfare with the invention of shell guns by Henri-Joseph Paixhans in 1824 (Baxter 1933:17,25). Adding layers of wood could combat damage from smoothbore cannon, but this approach offered no protection against shells. Coupled with the accuracy of rifled cannon, shells were devastating to wooden vessels, ultimately ending production of wooden ships of the line over the next four decades. It was the shell gun's effectiveness that ignited interest in armor plating. United States Admiral John Dahlgren improved upon Paixhans' design, creating a more accurate gun capable of firing shells and solid shot.

British and French naval success during the Crimean War in 1855 was in part due to iron-plated floating batteries. These unseaworthy craft were essentially floating boxes, useful for firing on fortifications, but not ship to ship combat. The batteries' flat bottoms made them poor sailing vessels. More platform than ship, the French fitted the batteries with leeboards for open ocean sailing (Baxter 1933:63). Despite poor handing, the batteries demonstrated the effectiveness of armor plating.

France launched the first ironclad ship *Gloire* in 1859. Iron plates protected the wooden frame-based ship above the waterline (Baxter 1933:95). *Gloire* was an improvement on the Crimean batteries in sailing ability and was able to fight at sea. Featuring a plum bow with a cut down deck to lessen weight, the ironclad was powered by a screw propeller and auxiliary sail.

The British responded with HMS *Warrior* in 1860, the first armor plated vessel with iron construction. *Warrior*'s combination of steam power, iron shipbuilding, armor plating, and propellers laid the groundwork for modern warships, though *Warrior* itself was obsolete within a few years due to the rapid introduction of new technologies. By 1861, the Royal Navy ceased building wooden ships of the line, except for those fitted with iron plate (Baxter 1933:140). The new technologies' benefits were recognized, but none of these warships had been used in battle. Therefore, the tactics and effectiveness of ironclad ships would not be fully understood until after the first generation of American armored vessels.

The United States attempted an ironclad vessel, the Stevens Battery, as early as 1841. The frame-based ship featured small casemates to protect the gun crews. The vessel's ends were submerged, similar to CSS *Virginia* and other Confederate ironclads built afterward. Designed to defend New York City's harbor, the Stevens Battery had an unrealistic scale, measuring 400 feet (121.92m) long. Despite three attempts at construction, the ship was never completed due to financial problems (Canney 1993:4-5).

Gloire, *Warrior*, and the Stevens Battery are all described as casemated ironclads by modern scholars (Baxter 1933:216; Sondhaus 2001:88; Konstam and Bryan 2001:17). The European casemate design differed conceptually from the Stevens Battery, as well as later Civil War casemates. Confusion stems from the term's vagueness. Casemate can mean a general enclosure for a warship's guns, a rampart, or an embrasure (Geiss 2009:226). These definitions fit each design, but their form and conceptual approach differ, as shown in Figure I.1. The European model used high gunwales, but construction differed little from unarmored ships. The Stevens Battery had iron ramparts on its deck. Finally, later ironclads, including many Confederate gunboats and the Union city-class, had a fully closed embrasure. Therefore, there are no similarities between these designs beyond general protective properties. Civil War contemporaries used the terms shield, embrasure, and gunbox interchangeably for Confederate casemates (*Official Records of the Armies* 1(33):56; Still 1961:342, 1985:93). Each of these three casemate designs had a separate philosophical approach, resulting in different construction. Differing conceptual approaches are not only found in casemate design, but also ship construction.

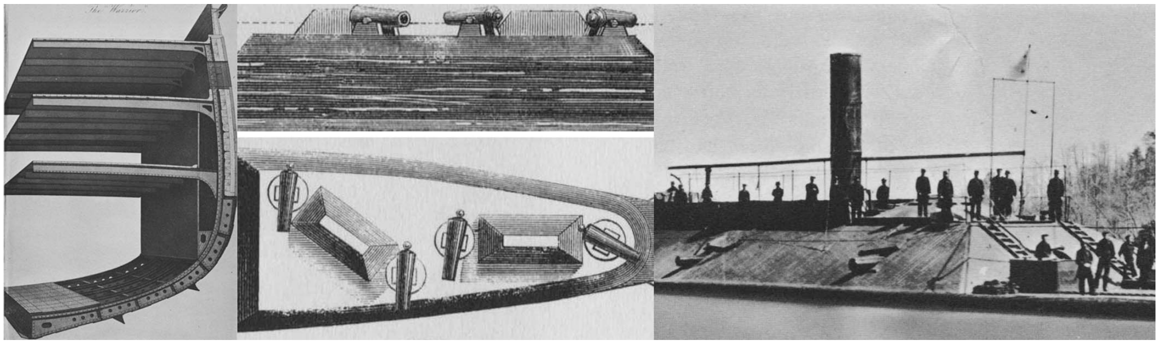

FIGURE I.1. The conceptual differences between the casemates on *Warrior*, the second Stevens Battery plans in 1861, and USS, formerly CSS, *Atlanta* (Stern 1962:44,46,139).

Confederate Naval Strategy

Confederate Secretary of the Navy Stephen Mallory recognized that armored warships provided the best opportunity to combat Union naval superiority. Not a single active vessel of the United States Navy fell to the Confederacy; however, nearly the entire Union fleet was wooden construction and vulnerable to armored warships. The latest European designs, equipped with shell guns and iron plating, would be devastating to these now outdated ships. Mallory wrote President Jefferson Davis, stating, “inequality of numbers may be compensated by invulnerability…” establishing a goal to purchase or build an ironclad fleet (Still 1969:8). Unfortunately, a navy did not play prominently in Davis’ mind because he believed the army would ultimately win the war.

In contrast, Union General-In-Chief Winfield Scott formulated the Anaconda Plan, utilizing the navy to blockade the Southern coast and control strategic river systems, such as the Mississippi. Scott’s plan forced the South to defend a very long coast without adequate vessels or fortifications. While the army slowly waged a war of attrition, the Union blockade severely affected the Confederacy's economy and access to resources, influencing ship construction (Still 2008:3). The cooperation that benefited Union forces eluded the Confederate army and navy for the duration of the war. The ironclad, as the culmination of mid-19th century technology, was the Confederacy's best chance to combat the Anaconda Plan, though the ships proved difficult to construct within the South.

Mallory hoped to purchase European ironclads that were built using the latest maritime technology including the steam engine, rifled cannon, shells, armor plating, and propellers (Brooke 2002:16). Manufacture of each required specific industries that were deficient in the South. Additionally, cost and speed, coupled with the recent developments in French and British naval technology, provided an impetus for purchasing over building. Therefore, Mallory first attempted to purchase ironclads, but a European arms race and Union diplomatic threats to European powers blocked this avenue to creating a navy.

The Confederate navy had a number of experienced naval officers who helped design and construct warships. Over two hundred officers resigned their United States commissions to join the Confederacy, providing an experienced base for ideas. The *Merrimack* conversion was designed by John M. Brooke and John L. Porter, while Porter and William P. Williamson oversaw construction. Porter designed the majority of ironclads built by the navy, though his assistant William Graves designed several. Only two ironclads designed by Graves were ever completed (Holcombe 1993:78). Several states and private individuals built ironclads designed by locals, such as CSS *Manassas*, CSS *Georgia, Louisiana,* and *Mississippi*. *Louisiana* and *Mississippi* were never completed or commissioned as Confederate States' ships, but other privately constructed ironclads were handed over to the navy upon completion. Mallory created a commission early in 1864 to discuss ironclad design and construction. This committee included Brooke, Porter, Williamson, and Graves (Still 1964:152).

The Confederacy believed that the initial five ironclads could break the Union blockade; however, *Virginia* demonstrated that casemated ironclads were too unstable for extended use beyond harbor defense (Still 1961:334, 1964:171). The embrasured casemate, or shield, became the signature of the Confederate vessels, being easier to construct than a turret. Mallory stated, "For river, harbor, and coast defense, the sloping shield and general plan of armored vessels adopted by us… are the best that could be adopted in our situation" (Still 1961:342). Every ironclad, except one at the war's end, was designed with a casemate for protection. By spring 1863, John M. Brooke noted that ironclads were exceptional for harbor defense, but not as offensive weapons (Brooke 2002:132). Mallory and Porter shared Brooke's conclusion, since all home-built ironclads after the initial five ships were specifically for defense (Still 1961:336). Mallory remained hopeful that ironclads built in Europe would break the blockade, but the Confederacy itself lacked the capability to construct one.

Confederate Shipbuilding

Mallory was cognizant of contemporary trends in naval architecture, but the South's few industrial facilities lacked the capability to implementation them (Holcombe 1993:6; Brooke 2002:108). At the height of its building program, the Confederacy had only three rolling mills, two factories producing engines, and two cannon producing ordnance works. Other essential maritime industries, such as ropewalks, were equally scarce. Shipbuilders and engineers were in short supply. Naval facilities were also lacking. Only two United States Navy yards, Gosport, Virginia, and Pensacola, Florida, were in the South. By 1862, Union forces held both yards, depriving the South of naval stores, machinery, and shipbuilding centers. Therefore, an interdependent shipbuilding system was created, connecting industry throughout the Confederacy (Still 1965:289).

In addition to facilities, basic materials were in low supply. Iron was perpetually in demand, slowing armor production and prohibiting iron shipbuilding. Wood was therefore used, since it was available in great quantities. There was not sufficient time to dry, or season, the wood, resulting in poor quality stock. Nearly every ironclad was constructed using green wood, causing hogging, sagging, and leaking. The two primary shipbuilding materials were therefore either insufficient in quantity or poor quality. Other essential maritime materials, such as oakum, rope, copper, bronze, and lead were desperately needed by other agencies within the Confederacy. Substitutes, such as cotton instead of oakum, were utilized. Several materials, such as copper, could not be substituted, causing disputes between the navy and other departments over limited supplies.

Resource deficiencies proved a major obstacle, resulting in delays. McBlair claims that twelve ironclads were never finished solely due to lack of iron for armor plating (McBlair 1880:604); while Still states that it was, in fact, eight vessels (Still 1971:98). CSS *North Carolina* sank at its mooring, in part due to leaking caused by use of green timber and cotton caulking (Watts 1999:14). Modifications, such as shortening casemates to use less iron, were necessary for many ships to be completed (Still 1961:333). In some cases, such as *Jackson*, ships were never completed due to ongoing modification.

Under the decentralized shipbuilding program, ships were constructed in one of three facility types: a government yard, a private yard under the direction of naval officers, or by contractors (Still 1965:290). The majority of ships were contracted, as Mallory believed contracts would generate a maritime industry. Contractors were typically local businessmen who operated under a supervising naval officer and paymaster. Construction plans were sent to contractors together with brief instructions from Mallory. A head shipwright, usually a local pre-war shipbuilder, would oversee civilian workers. The workforce was composed of local hired hands, soldiers detailed to help, donated slave labor, and local volunteers. Shipbuilding generated local business for cobblers, treenail manufacturers, and machinists. The Navy Department transported experienced shipbuilders to various shipyards to lend experience (Bright et al. 1981:10; Turner 1999:172; Still 2008:33). Officials, such as Chief Naval Constructor Porter and Chief Engineer Williamson, visited shipbuilding sites to aid construction, as did Naval Constructor William Graves, naval officer Lieutenant Robert Minor, and Navy Department civilian contractor Asa Tift.

The loss of the Gosport and Pensacola naval yards, as well as other shipbuilding centers such as New Orleans, forced the navy to create new shipyards in the second half of 1862. The new yards were located far inland on rivers, beyond the reach of Union coastal assaults. The shipbuilding program was overhauled and at least ten inland yards were created, including those where *Neuse* and *Jackson* were laid down. The new yards were located on railroad lines, except for Shreveport, but nevertheless experienced difficulty obtaining materials.

Employing contractors and inland yards was an attempt to maximize resources within the decentralized shipbuilding program, but their use affected both design and construction. First, four of five vessels constructed were ironclads, due to their gunfire resistant nature (Still 1985:144). Second, designs were simplified, allowing house carpenters to be used due to the shortage of experienced shipwrights. Emphasis was placed on speed and ease of construction. As the war progressed, ships' timber types simplified, favoring straight timbers over curved due to its straightforward manufacture. The casemate's built-on knuckle was replaced by a simple flared side (Still 1964:158). Viewed head on, the ships resemble a diamond, as shown in Figure I.2, lending its name to this vessel type, the diamond hull ironclads. This typology is a modern construction, but all diamond hull ironclads share specific characteristics beyond the shape created by the knuckle (Still 1985:96; Holcombe 1993:92). Actually hexagonal in shape, these ironclads might be better termed "inland ironclads," since all ironclads of this type were built on rivers at inland shipyards.

Information on actual construction methods is scarce. Numerous sources related to shipbuilding survive in the historical record, though the actual process is not detailed. The navy's archive was destroyed at Charlotte, North Carolina, perhaps the best sources for Confederate shipbuilding methods. Hints survive, offering clues but nothing substantial. Chief Engineer James Warner mentions non-traditional techniques were used, stating, “The method of construction adopted… [is] not in accordance with the best practice of naval architecture” (Holcombe 1993:133). Precise methods were likely overlooked due to their ordinary nature or, perhaps, because of the shipbuilders’ concern for naval architects’ disapproval. Following the war, while many naval and army officers recorded accounts of battles, few shipbuilders followed suit documenting their methods. Gilbert Elliot, builder of *Albemarle*, wrote an eight-page article in *Century Magazine*, but only five brief and general paragraphs were devoted to construction. Therefore, the archaeological record is the best source on Confederate ship construction.

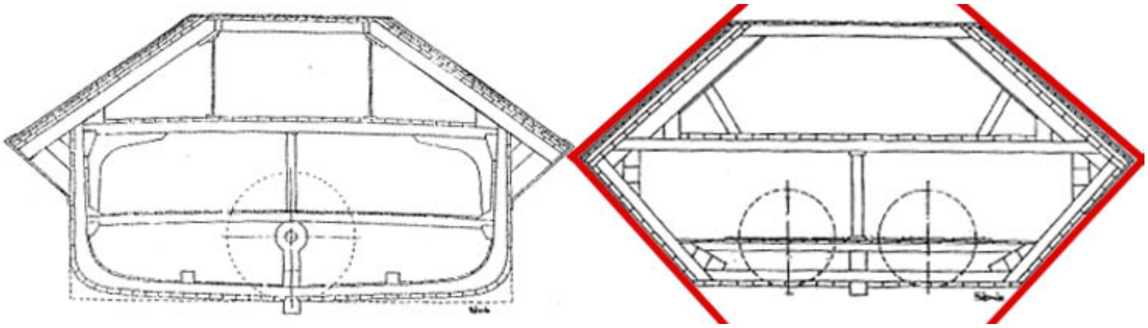

FIGURE I.2. *Richmond*’s built-on knuckle compared to *Albemarle*’s flared knuckle, which gives a diamond shape (Holcombe 1993:67,99).

Despite its lack of industry and resources, the Confederacy pioneered important naval technologies that would become standard in later wars, including armored warships, submarines, torpedo boats, mines, and shallow drafted gunboats. Twenty-two ironclads were commissioned and seventeen saw combat, along with the non-commissioned *Louisiana* which was used as a floating battery during the defense of New Orleans (Still 1985:227). Despite the Confederate navy’s failure to get completed ironclads into pitched battles, the Union forces nevertheless respected Confederate technology. In fact, a major reason for the absence of pitched naval battles between

Confederate ironclads and blockaders was the Union strategy of avoiding the unseaworthy craft until the Southern gunboats had to return to port. Admiral David Farragut held *Arkansas* in high esteem, while Lieutenant-commander W.E. Fitzhugh described *Missouri*'s "ingeniously contrived pivot carriage" (McBlair 1880:603; *Official Records of the Navy* 1[27]: 241). "Ram fever" kept the Union navy on high alert, giving the Confederacy a fleet-in-being while many ironclads were still under construction (Keeler 1968:66; Still 1985:171). The Confederacy's sophistication is counterintuitive to researchers who view history retrospectively, cognizant of the shipbuilding program's outcome. This cognizance has caused Confederate ship construction to be overlooked, although a deliberate, logical, and intelligent progression of shipbuilding traits are shown in the archaeological record.

Archaeology

Fortunately, of the ironclads completed or nearly completed, *Georgia*, *North Carolina*, *Raleigh*, *Tuscaloosa*, *Huntsville*, *Phoenix*, *Neuse*, and *Jackson* survive to varying degrees in the archaeological record. Two of these, *Neuse* and *Jackson*, are currently available for study in museums. Additionally, two unarmored wooden gunboats, the Chicod Creek vessel and the *Chattahoochee,* have been recorded by archaeologists. Analysis of *Neuse* and *Jackson* and comparison with the other ships allows for the progression of Confederate ship construction to be ascertained.

The archaeological sites are approached based on arguments by Steffy (1994), Hocker (1991, 2004:5), and Alford (1998). First, Steffy argues that shipbuilders' underlying conceptual approach to construction can be identified, distinguishing a shipbuilder’s “set of assumptions, cultural and personal biases, and technical experience” (Steffy in Hocker 2004:1; Steffy 1994). Secondly, by identifying diagnostic timbers and their function, a ship’s assembly order and structural system can be identified (Hocker 1991, 2004:5). Finally, elemental structural systems change gradually, though form may change rapidly (Alford 1998:443). Ship form changes often, such as wartime influences, but the conceptual approach is identifiable by the assembly order and structural systems. Shipbuilding traditions, such as frame-based, shell-first, and bottom-based construction, have separate conceptual views about what composes watercraft. Frame-based shipbuilders view ships as a skeleton with a watertight skin, while the shell-first approach builds vessels as strong shells reinforced by framing. Bottom-based construction view ships as a strong bottom with sides added on. This thesis expands on authoritative works by historians Baxter (1933), Still (1961,1964,1969,1971), and Holcombe (1993,1997) as well as archaeological research by Hocker (1991,2004).

Many researchers of the Industrial Revolution have not followed Marx’s model of examining the period’s “knowledge, tools, and labor”, but focus instead on the “arms.” Archaeological sites from this timeframe show a mixture of new and old concepts. New ideas were adopted rapidly, skipping the initial development phases (Diveley 2008:276-277). The introduction of so many new technologies created confusion about their implementation, described as the “archaeology of tactical indecision,” creating a challenging, though enlightening, task for researchers (Gould 2000:268). In some cases, naval architects combined new and ancient technology, such as steam engines and rams.

Rather than studying this mixture of ideas, salvagers, enthusiasts, and some archaeologists simply report superficial artifact descriptions. Examination of the process rather than product provides archaeology's version of anthropology's "thick description" (Geertz 1973). Clifford Geertz states anthropologists should move beyond "thin descriptions," which only describe a product, and strive for "thick description" that explains meaning and culture (1973:3). Geertz explains that a wink can be described as an inconsequential twitch of the eye, or it can be given a thick description that recognizes a wink as a deliberate cultural act with multiple meanings.

Archaeology, as a sub-discipline of anthropology, must move beyond thin descriptions and implement anthropological theory for site interpretation. Rather than mere descriptive analysis, thick description of the physical record allows for interpreting the knowledge, tools, and labor used in the industrial process, in this case, examining the Confederacy's conceptual approach to building warships. In 1861, Confederate shipbuilding was similar to general shipbuilding throughout the United States, but construction plans and archaeology show that, by late 1862, wartime stimuli created a particularly Confederate shipbuilding style. Transformations in ships' timbers and method of assembly show a divergent conceptual approach to construction, beyond simple form change, than existed before the war or elsewhere in North America. Interdisciplinary analysis of the Confederate ships *Neuse* and *Jackson* reveals a hybridization of pre-war shipbuilding traditions supplemented by technology developed during the Industrial Revolution, but constrained by certain limitations within the South. Examination of *Neuse* and *Jackson* provides details on the conceptual approach to shipbuilding though diagnostic traits and the construction process. Comparison between these two ships provides insight into the decentralized shipbuilding program, the implementation of Porter’s designs by local vernacular shipbuilders, non-traditional methods used, and the progression of Confederate ship construction.

CHAPTER 2: INFLUENCES ON CONFEDERATE SHIP CONSTRUCTION

The near overnight change from constructing fishing boats to ironclads in the South is an excellent case study for examining continuity of ships' structural systems despite change in form. Many theoretical models have attempted to understand the transfer of old and new ideas in shipbuilding, with each being replaced after a few years. The transition from peace to wartime was rapid enough that problems of continuity, often discussed by diffusionist and systemic theories in ethnoarchaeology, are rendered mute (Hocker 2004:8). Conversely, much Civil War research has examined wartime shipbuilding as if the practice began in 1861. Rather than adopting new methods, shipbuilders continued to use familiar traditions and methods for the new wartime designs.

New warship designs, such as the diamond type ironclad, are always speculative. When laid down in 1862, the success of *Neuse* and *Jackson* was uncertain, though today researchers know the ships were completed and launched. Historian Veronica Wedgwood perceived, "History is lived forward but written in retrospect. We know the end before we consider the beginning and we can never wholly recapture what it was to know the beginning only" (Horwitz 1998:334-335). This retrospective observation is echoed as a forethought by naval historian John D. Milligan. He states that success of military technology is only evident once proven in battle, not during development (Milligan 1984:126). In the Confederacy, naval architects and shipbuilders could not be certain which untested designs would prove effective.

Though acknowledged as a success today, *Virginia* was purely an experimental ship (Still 1964:155; Brooke 2002:71). In the vacuum between design and reality, many doubted *Virginia* on the day of its launch (Davis 1881:156; Porter 1892:338). In fact, even ironclad advocates were eventually proven wrong, as the vessels were ineffective without supporting forces at sea or on land (Milligan 1984:126), much like the tanks of World War I. As the third generation of ironclads, the diamond hull incorporated earlier vessels' successful features in an untested shallow draft design. Therefore, to attempt to "recapture what it was to know the beginning only," an examination of traditions that shaped Southern shipbuilding before and during the war is required. Four primary non-traditional influences formed the knowledge of Confederate shipbuilding, listed by latest to the most long-standing:

1. Novel and adaptive design
2. Vernacular shipbuilding and local innovation
3. Western river steamboats
4. Bottom-based shipbuilding

A general history of each follows, showing the diffusion of ideas and how each were viewed prior to the diamond hull ironclads, during their construction and modification, and, finally, upon completion. Archaeology is heavily skewed toward ocean-going ships; in fact, few purpose built river craft have been heavily studied (Kane 2004:xix; Rodgers et al. 2009:54). As the most popular form of construction, frame-based shipbuilding influenced shipwrights, but its traits are minimally seen in the hybrid construction. The traditional frame-based construction method is also addressed. Each generation of Confederate ironclad is examined in depth by Robert Holcombe in his seminal work on the topic (Holcombe 1993), providing much of the fundamental interpretation about these ships.

Novel and Adaptive Design

The Confederacy's Chief Naval Constructor, John Porter, was an experienced naval architect by 1861, having worked for the United States Navy at both the Gosport and Pensacola navy yards. He worked on the construction of the USS *Alleghany*, *Powhatan*, *Colorado*, and *Pensacola*, and he also designed and built *Seminole* (Porter 1892:329). In 1847, he failed his appointment to become a full constructor, though he succeeded in 1857 and he began work on *Seminole* the same year (Wells 1971:97). During the intervening ten years, Porter was master shipwright in the Gosport yard, where he oversaw a number of projects, including *Constellation,* which was dismantled and rebuilt as a sloop in 1854 (Park 2007:15). By 1861, he was experienced with the latest technology including iron construction, steam engines, and propellers. Porter worked on experimental designs as well, including an ironclad in Pittsburg and the Hunter wheel, a submerged horizontal paddlewheel. Porter's experience caused him to favor certain design features that are found in both his pre-war and wartime designs. Examination of these designs shows the leading Confederate naval architect's conceptual approach to construction.

The first ship Porter built for the Navy is characteristic of his designs. *Seminole* was a wooden steam sloop that served the Union throughout the war, including assisting in the capture of CSS *Atlanta*. *Seminole*'s design features wooden construction with a keel, curved bilge with little deadrise, and twin propellers. *Dacotah*, in Figure II.1, had similar lines to *Seminole* since both were *Mohican*-class, though *Seminole* was smaller in length, beam and draft, as well as being built slightly fuller (Canney 1990:82). This frame-based construction was typical for United States Navy vessels, including those Porter worked on, such as *Colorado*, and its sister ship *Merrimack*. Launched in 1859, *Seminole* experienced operating difficulties and charges were leveled against Porter. An investigation followed, claiming problems with bilge pumps, decking, and other fittings were due to Porter's ineffectiveness as a constructor. The judge exonerated Porter, even commending him on building the vessel cheaply and strongly (National Archives 11W4[14/10/D]:Box 22). After a refit that cleaned the bilge pumps and replaced decking, *Seminole* passed inspection and after an engine refit in 1863, it was recognized as a fast vessel (Canney 1990:82).

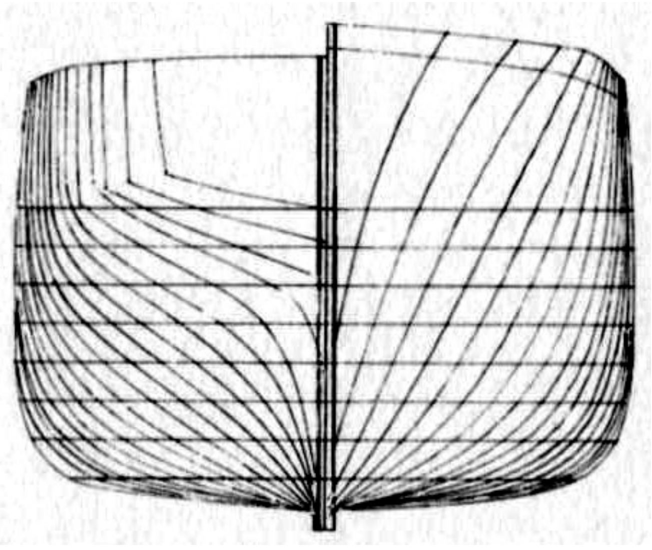

FIGURE II.1. *Dacotah*'s lines, similar to *Seminole* (Canney 1990:82).

While working on the iron sloop *Alleghany* in 1846, Porter presented the navy with plans for a casemated ironclad. Below the waterline, the design is identical to *Seminole*, with a prominent keel, curved bilge and little deadrise. The casemate, shown in

Figure II.2, is similar to *Virginia*'s projecting below the water to create "eaves" that protect the vessel from shots at the waterline. The plans also include an iron deck protecting the berth deck from shot penetrating the casemate. The plans also show use of the submerged horizontal Hunter wheel, rather than the standard paddlewheels, suggesting that, by 1846, Porter recognized the tactical disadvantage of exposed paddlewheels. It is from the Pittsburg ironclad's plans that Porter would approach his later armored warship designs.

FIGURE II.2. Midship section of Porter's 1846 ironclad design (Porter 1892:328).

Porter's views evolved between 1846 and 1861 due to European ironclad developments. The Crimean batteries and construction of *Gloire* and *Warrior* were discussed at length in naval architecture publications. Information traveled quickly within the community and articles often included detailed information and illustrations, even before ships, such as *Gloire* and *Monitor*, were launched. Russia laid down seventeen Eriksson type monitors in 1863 and all were in operation before the end of the Civil War (Gould 2000:271). As a United States Navy constructor, Porter was undoubtedly cognizant of these discussions. Mallory's letters show that he also kept abreast of the latest developments. The ram is the best example of the association between the Confederate brain trust and naval architectural discourse.

Royal Navy Admiral George Rose Sartorius advocated ramming during the Crimean War, reminiscent of Greco-Roman navies (Gould 2000:272). This was one result of steam engines allowing ships to travel against wind or current, allowing the maneuverability of rowed vessels for the first time since the galley. Ships used for linear fighting with broadsides were vulnerable to ramming attacks, so tactics changed once rams were introduced (Sondhaus 2001:96). The Royal Navy continued use of the ram into the 1860s.

Porter's earliest plans did not show a ram and, in fact, he complained about the ram's addition to *Virginia* (Holcombe 1993:11; Porter 1862c:11). Brooke's plans likewise did not include a ram, though he suggested one could be added (Holcombe 1993:8-9). The person responsible for adding the ram to *Virginia* is unknown, but its success led to adding a ram on most Confederate ironclads that followed. Brooke's notebook does not mention a ram until 3 November 1861, stating that Mallory told him to explore the possibility (Brooke 2002:45). Confederate ram use is likely due to its popularity European discourse. Mallory received a number of proposals to construct rams, showing the idea to be commonly known (Still 1985:11). The privately built *Manassas*, built before *Virginia*, was actually the first ironclad ram commissioned (Holcombe 1993:21).

Rams' continued use despite their ineffectiveness in pitched battles proves that the weapon was a popular trend rather than an innovative tactical device. Successful hits were experienced only during surprise attacks on vessels at anchor or in confined spaces. In addition, *Virginia, Manassas,* and *Albemarle* damaged and nearly sank themselves after ramming enemy ships (Still 1985:30, McBlair 1880:606, Elliot 1888:423). *Palmetto State,* together with *Chicora,* surprised and rammed USS *Mercedita*, although the Union ship was disabled by a shell destroying its boiler (Still 1985:120). The result of the ramming was negligible compared to the shell's damage. In all, only *Albemarle* had an offensive result, the rest did not affect overall Union control.

The 1866 Battle of Lissa is the sole example from the period of ramming during a pitched battle at sea. The Austrian flagship *Erzherzog Ferdinand Max* rammed the Italian flagship *Re d'Italia* after the Italians had mistakenly run in their guns (Gould 2000:274). The Austrian ship was heavily damage in the attack and had to withdraw after sinking *Re d'Italia*. The ram's unfavorable results did nothing to stem its popularity. Naval architects continued to fit warships with rams into the 1870s. Untested before the Civil War, and ineffective in battle during the war, the appearance of rams on Porter's post-1860 designs indicates he incorporated popular European naval trends.

Porter undoubtedly knew of the turret, but as a realist, he simplified his designs. The turret had been discussed by a number of prominent naval architects since at least 1798 (Stern 1962:42). Porter recognized the casemate as a better option for the under industrialized South. On several occasions, both Porter and Mallory were asked if the South could construct a turret. Mallory replied, "For river, harbor, and coast defense, the sloping shield and general plan of armored vessels adopted by us… are the best that could be adopted in our situation" (Still 1971:93-94). Late in the war, a turreted ironclad was planned in Columbus, Georgia, where the industrial infrastructure had developed since 1861 (Holcombe 1993:134). Interestingly, Peru built an embrasured casemate ironclad, *Loa*, when fighting Spain. Launched in 1865, *Loa* used railroad iron similar to the Confederate *Arkansas* (Greene and Massignani 1998:264-265). The Confederate and Peruvian industrial and naval situations were strikingly similar, demonstrating that the embrasured casemate was the simplest form of armored gunboat to produce.

Abreast of the latest designs, Porter likely studied the construction of the Crimean batteries as well as *Gloire* and *Warrior*. The batteries are strikingly similar to late 1862 Confederate construction. Built with a flat bottom and no keel, the batteries had seven bilge keelsons and a heavily built chine (Holcombe 1993:5). Though the method of construction is unknown, the structural elements suggest bottom-based construction.

The Confederate naval administration probably envied *Warrior*'s iron construction, but the wooden construction, similar to *Gloire*, better fit the South's resources and industrial capability. The French vessel was a wooden, frame-based vessel with iron plate fitted to the exterior. The midship section was similar to *Seminole*. *Warrior*, alternatively, was the first modern warship featuring steam power, iron construction, armor plating, propellers, and shell guns. Both ships were ocean going, a trait that escaped Porter's ironclads because the embrasured casemate created a top-heavy vessel.

When the war began, Porter revisited his 1846 design, simplifying it to "bring it within the power of the Southern Confederacy to build," and creating a harbor defense vessel (Porter 1892:329). Shown in Figure II.3, the vessel's plans show a keel, a bottom with no deadrise, and a sharp chine. Porter's history and the presence of the keel suggest frame-based construction; however, the flat bottom and hard chine show he recognized few experienced shipbuilders were available. The obvious simplification confirms Porter's misgivings about the Southern capability to construct a modern warship. The plan demonstrates the naval constructor's attempts to limit building time while maximizing resources. Use of the casemate design, pre-existing engines, and makeshift construction yards furthered this strategy.

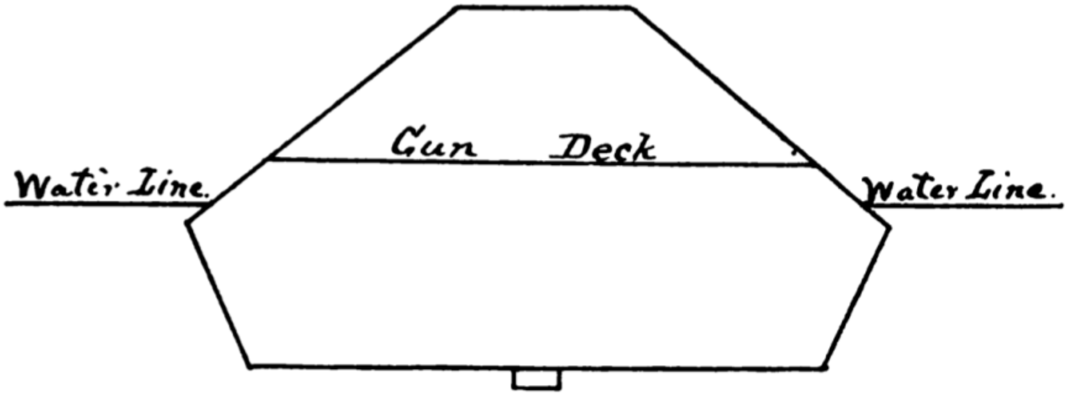

FIGURE II.3. Midship section of Porter's 1861 design, created specifically for the Confederacy's shipbuilding and industrial conditions (Porter 1892:329).

All Porter's wartime home-built designs emphasized key attributes for ease of construction and functionality. The construction plans' midsections are boxy, allowing the addition or subtraction of frames to alter the vessel's length, a feature Porter used on ironclads and wooden gunboats (Still 1969:13). This type of extension was also used Lake Champlain sailing barges and post-World War II tankers (Cozzi 2000;Gould 2000:4). The *Albemarle*-class was lengthened to create *Fredericksburg*, making use of this adaptable function. Ease of modification was required for Confederate shipbuilding conditions. Conversely, Porter's overseas designs show a higher level of complexity (Porter 1862b:5-6).

Porter's design for the *Merrimack* conversion is based on this simplified plan. He brought a model to his first meeting with Mallory, Brooke, and Williamson. Mallory chose Brooke's ironclad design over Porter's, while the group decided to convert the scuttled *Merrimack* into an ironclad (Brooke 2002:22). Brooke's design differed in a number of ways, including being an offensive weapon rather than for harbor and coastal defense. The form below the waterline matched the ocean-going *Merrimack*, featuring a keel and twenty-foot (6.7m) draft. Above the waterline, *Virginia* proved to be the prototype for later Confederate ironclads. The converted ironclads were examples of pre-war construction, so it is not until ships were built from the keel up that Confederate shipbuilding became a distinctive practice.

Arkansas was one of the first ironclads laid down, in October 1861. Begun in Memphis, Tennessee, but completed on the Yazoo River, historical accounts indicated the construction method was unorthodox. One officer wrote that *Arkansas* combined attributes of both flat riverboats as well as frame-based ocean steamers (Still 1971:96). Another described the construction underway, saying, "the keel laid, the ribs and framework in place" (Still 1971:63). *Arkansas*' descriptions match an unnamed construction plan in the National Archives, ascribed to Porter (Holcombe 1993:42). The *Arkansas* plans are possibly the earliest Porter wartime construction design, in comparison with conversions, such as *Virginia*.

The *Arkansas* plans show the same features as Porter's earlier designs. The design below the waterline is similar to *Seminole*, as seen in Figure II.4. The vessel has little deadrise and a curved bilge. Historical accounts and construction plans imply frame-based construction. The embrasured casemate's sides are vertical, similar to *Gloire* and *Warrior,* though without open decks, rather than inclined like later Confederate ironclads. Brooke conducted tests on angled armor concurrently with the laying of *Arkansas*' keel. His results were too late for *Arkansas*, though he noted vertical plating was more seaworthy than inclined (Still 1964:159).

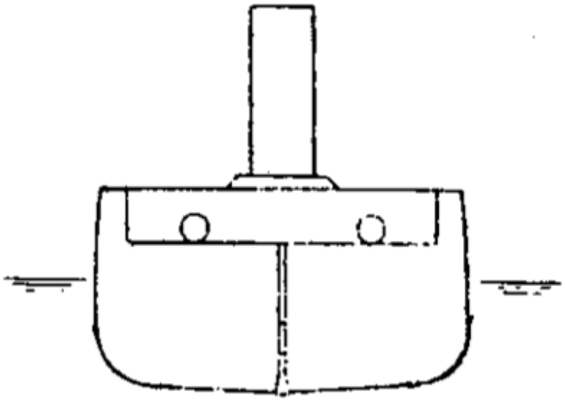

FIGURE II.4. *Arkansas*' bow view, with a similar design to Porter's previous vessels (Holcombe 1993:41).

As the war progressed, military technology experienced a type of natural selection. The mechanism of this martial selection process was success in battle, as suggested by Milligan. Experimentation increases during conflict and ideas rejected during peacetime, such as Porter's 1846 ironclad, resurface. The rapid adoption of steam over sail during the Crimean War had one admiral remark that war was "hardly declared when already the opinion of the few became the opinion of a majority" (Greene and Massignani 1998:35). Experimental features perceived to be successful in the early designs were maintained, while unsuccessful features were eliminated, guiding the diffusion of new technologies. Mallory stated that "Every vessel should be, and is, an improvement preceeding [sic] one…and we are profiting as well by their successes as by their failures" (Still 1985:99-100). Building full-length casemates, such as *Virginia* and *Georgia*, could not continue due to the amount of time required to build them, as well as the scarcity of iron. Smaller casemates led to using pivot guns in every diamond hull ironclad (Still 1964:159). The eventual appreciation for shallow water operations resulted in use of smaller casemates to decrease draft.

Ironclads laid down in 1862 feature shortened casemates with low profile decks. *Neuse*, *Jackson*, *Tennessee* II, *Columbia*, *Texas*, *Milledgeville*, and *Virginia* II are all second-generation ironclads modified due to iron shortage. Porter's design by the end of the war, *Wilmington*, featured two small separate casemates, each with a gun, like immobile turrets. This design is similar to USS *Keokuk*, though each naval architect reached this design from separate routes, Porter attempting to save iron and Charles Whitney mimicking turrets. Another case of the selection process is spar torpedoes' early success, which led to them being fitted on ironclads (Peebles 1996:37). Martial selection led to standardized designs bearing specific characteristics.

Porter standardized designs beginning with the *Richmond*-class, followed by the *Tennessee* (II)-class (Holcombe 1993:68). Both classes featured a built-on knuckle and draft around fourteen feet (4.27m). Archaeological remains of *North Carolina*, a *Richmond*-class ironclad, show frame-based construction (Watts 1999:25). Planned for harbor defense, these vessels were built near the ocean and their draft indicates deeper operating conditions than the diamond hull ironclads.

The diamond hull ironclads consist of at least three classes designed by Porter and laid down in late 1862. Contemporaries referred to ironclads as "schooners," although these ships had no mast or rigging, instead deriving the name from having a single deck. The *Albemarle*-class consists of *Albemarle*, *Neuse*, and an unnamed ironclad destroyed during its construction in Tarboro, North Carolina (Holcombe 1993:96). This class utilized twin propellers for propulsion. The *Fredericksburg*-class is a larger version of the *Albemarle*-class with double pilothouses. The *Missouri*-class included *Missouri* and *Jackson*, which utilized a center paddlewheel for propulsion.

Several other diamond hull ironclads were laid down, though they were not given a specification. Four to eight were planned for the Dismal Swamp, before the Union capture of Norfolk (Holcombe 1993:93). *Tuscaloosa* and *Huntsville* were twin screw ironclads with minor differences from the *Albemarle*-class. So little was known of them until recently that no class name has been assigned to them.

Though only seven were completed, as many as twenty diamond hull ironclads might have been planned (Holcombe 1993:92-116). After *Virginia*, *Albemarle* arguably had the most successful career of all Confederate ironclads. *Neuse*, *Fredericksburg*, *Missouri*, *Tuscaloosa*, and *Huntsville* received their commissions and were eventually scuttled to prevent capture. *Neuse* and *Missouri* were limited by their inland building sites, while *Fredericksburg*, *Huntsville*, and *Tuscaloosa* were hemmed in by land victories. *Jackson* was nearly completed, but not commissioned, when Union cavalry burned it.

There are variations between the *Albemarle*-class construction plans and plans that might be for the Selma ironclads, *Tuscaloosa* and *Huntsville*, entitled “Gun Boat No. 1” (Holcombe 1993:96). The primary difference is an angled pinknuckle timber, the transition piece between the flat bottom and angled sides. This timber is found on a number of western river steamboats, perhaps illustrating Porter adopting common river craft traits for his plans, as was seen in the *Missouri*-class (Holcombe 1993:95, Kane 2004:101). If construction on the ironclads proceeded at the same pace as the *Albemarle*-classes, then by the time the contract was signed for *Neuse* in October, Porter may have had time to inspect the nearly completed Selma vessels. This might indicate that the *Albemarle*-class is a second generation, but this is currently speculative. A thorough archaeological examination of *Tuscaloosa* or *Huntsville* might provide this information, in addition to confirming if the ships were built according to the Gun Boat No. 1 plans.

Porter has been described as stubborn, uninventive, and neglectful, mostly for his continued use of wood construction and the embrasured casemate design (Wells 1971:98; Park 2007:193). The progression of Porter's designs shows cognizance of major naval trends and attempts to use them within the Confederacy. Each improvement was limited, but the knowledge could not be used due to inadequate materials, tools, and labor. Porter's designs show foresight and adaptability, allowing a modern warship to be built in far from ideal conditions.

Vernacular Shipbuilding and Local Innovation

Contractors executed the majority of Confederate naval construction; Mallory and Porter allowed shipbuilders a measure of freedom. This method was adopted to provide maximum expediency, due more to decentralization than effectiveness. The contractors typically had no experience constructing warships. Nelson Tift, the builder of *Mississippi*, was a farmer with no shipbuilding experience (McBlair 1880:598). Martin and Elliot had only built flatboats prior to *Albemarle* (Maffitt 1880:501). These builders took direct control over construction. Several contractors never took part in construction themselves, such as Elijah Ellis, who acted as financier for *Neuse* and remained in New Bern after its capture (Still 2008:26). His partner, Thomas Howard, was a pre-war shipbuilder who oversaw construction in Whitehall and helped with the fitting out in Kinston (Bright et al. 1981:6,13). Porter sent contractors the construction plans, general instructions from Mallory, and a naval officer to oversee projects. The resulting vessels generally resembled the construction plans, but the plans were executed using local traditions and innovation, known as vernacular construction, producing ships that reflect local shipbuilders.

Vernacular refers to a localized, either geographic or cultural, tradition expressed through design or technique. In architecture, vernacular construction indicates a local tradition that is handed down and adapted to local resources and technology (Asquith and Vellinga 2006:1). Anthropologist Margaret Lantis accurately describes vernacular as “culture-as-it-is-lived appropriate to well-defined places and situations” (1960:203). Culture, environment, and economy directly affect the knowledge, labor, and tools of craftsmanship, resulting in a product reflecting the local group.

After 250 years of colonization prior to the start of the Civil War, local environment and time had acted as a mechanism for vernacular culture. The result was the creation of distinct groups, as inland ship construction diverged from that in coastal areas. For example, western river steamboats developed a different form, structural system, and propulsion than their ocean going counterparts. Separate traditions are found in areas as similar as the Neuse and Chattahoochee rivers.

Local Southern shipbuilders used methods familiar to them when actually creating the ironclads. Significantly, though vernacular shipbuilding is found throughout the world, it is rarely found in navies. Vernacular craft developed for local conditions, while warships usually operated in diverse areas. A disproportionate number of vernacular craft are found in the Confederate navy, due to the lack of centralized control over each vessel's construction.

This leeway is clear in Mallory's instructions to shipbuilders. The instructions to the Tift brothers and Weldon & McFarland are nearly identical, suggesting copies were sent out with each contract.

> You will not regard yourselves as confined rigidly to the specifications, but will feel at liberty, should you deem it necessary to render the vessel more efficient, to vary them for such purpose and no other; adhering generally to the specifications, and report all deviations promptly to the Department for approval (*Official Records of the Navies* 2[1]:602).

Archaeology provides the best analysis of local construction and modification. Richard Steffy categorizes vessels by intended use, since design and construction differ based on predicted conditions (Steffy 2006:10). A naval vessel is constructed differently than a utility vessel because the stresses are different. This concept, together with Alford's principle on structural systems' resistance to change, leads to the conclusion that Confederate contractors were using local vernacular utility vessel construction on a much larger scale and for a different function. A 15th century example of this is *Grace Dieu*, which used lap-strake construction for a fourteen hundred ton warship (Hocker 1991:171;

Steffy 2006:114). To cope with these changes in scale and function, several Confederate contractors went beyond vernacular traditions and attempted innovative approaches.

Innovation denotes a new method, rather than one derived from a tradition. *Mississippi* is an example of local innovation. Nelson Tift's design and construction were formulated in the land-locked farmer's mind and had no basis in any shipbuilding tradition.

> His device was designed to obviate the difficulties arising from the great scarcity of shipbuilders and the equal scarcity of the crooked timber that they employed. The hull of an ordinary vessel is made of a skeleton of futtocks, curved ribs, and crooked cross-knees, to which the planking, artificially bent to follow the lines of the model, is bolted outside and inside. The plan of the Tifts dispensed altogether with this complicate framework, and substituted for the sides of the vessel a solid wall of pine planks built with the requisite thickness upon a flat bottom, and having only straight lines and flat surfaces except at the junction of the sides with the ends. This plan made available for every purpose of the structure, from stem to stern, the tall straight timber of the Southern forests, and the simplicity of it placed the work within the capacity of ordinary house carpenter and joiners (McBlair 1880:598).

This passage exemplifies local innovation despite the Confederacy's problems. The description suggests a bottom-based vessel, but construction is intuitive, rather than stemming from a tradition. This construction went against conventional naval architecture of the day, but the Confederate situation required innovative approaches. Unfortunately, *Mississippi* was never completed, although Union Admiral David Farragut and Confederate naval officers held the ship in high esteem (McBlair 1880:597).

Vernacular culture and local innovation influenced Confederate ironclads in two respects. First, shipbuilders used local methods in the construction of the warships. Second, techniques perceived as successful in early ironclads were transferred to later ones. For example, the construction features such as full frames, straight timbers, and house carpentry used on *Mississippi* are also found on diamond hull ironclads. Vernacular culture and local innovation also played a large role in developing western river steamboats, the third influence in the diamond-type ironclads.

Western River Steamboats

Both Union and Confederate navies sought experienced shallow draft shipbuilders, often western river steamboat constructors. Robert Fulton first introduced a steamboat, *New Orleans*, to the western rivers in 1810. In response to Fulton, several steamboats were soon operating on the rivers. Henry Shreve developed the first true western river steamer in 1815. His novel design utilized a shallow hold with two decks, placing horizontal engines on the deck, differing from Fulton's transplant in both construction and engines. Shreve's design allowed a shallow draft, yet increased cargo capacity on the two decks (Dorsey 1941:106-107). This design revolutionized river transport in the United States and later steamboats improved upon this basic design, rapidly developing a tradition.

The steamboat was introduced to the North Carolina sounds in 1818, while the first steamboat was introduced to the Chattahoochee River in 1827 (Bridgers 1978:4; Mueller 1990:16). The Chattahoochee River was navigable up to Columbus and the Neuse River could be sailed as far upstream as Goldsboro (Popp 1872:739). These lightly constructed vessels made poor naval vessels, but Confederate shipbuilders borrowed certain shipbuilding techniques from them.

By 1861, the author argues, western river steamboats had developed into a distinctive conceptual approach to construction. Rather than having a frame-based conceptual model like early 19th century river steamboats, western river steamboats were flexible platforms strengthened by iron trusses. The typical western river steamboat featured a minimal hold, with passengers and cargo placed above deck. According to Mark Twain, the ships were so shallow drafted that they could float on dew (Corbin 2009:62). By the middle of the century, river steamboats had grown to impressive sizes and their construction had developed specifically for the North American inland waterways. Demand was high, creating large profit margins. Capital invested in steamboats aided in the rapid development of the western river steamboat. The average vessel wrecked within four years, but even those that survived were typically replaced within five years (Hunter and Hunter 1994:100-101).

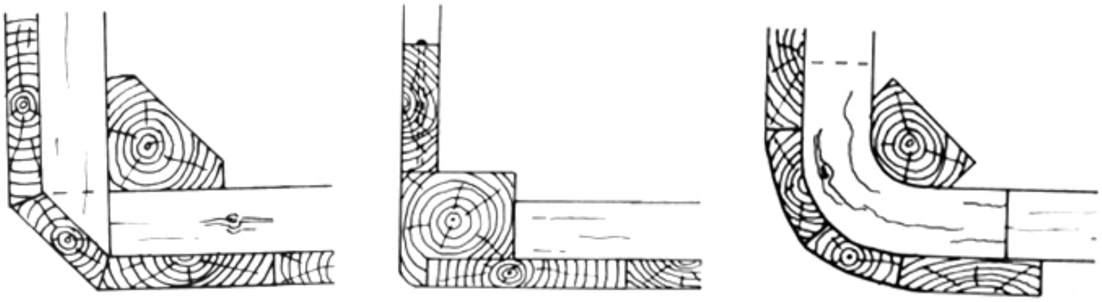

FIGURE II.5. Standard chine, chine log, and frame-based construction types on western river steamboats (Kane 2004:101,102,104).

Basic western river steamboat construction consists of a flat bottom, hard chine, and no keel, although an alternative frame-based form with a rounded bilge existed, as shown in Figure II.5 (Kane 2004:101,102,104). To create such a shallow draft, a hard transition was required between the bottom and sides. The method used to join and strengthen this transition is the most revealing for ships of this type. The chine is reinforced through one of two methods, chine logs or use of cocked hat timber, a filler to fill space and add strength (Kane 2004:101,102). The sides are vertical or near vertical and there is a straight run aft of the bow. Vessels' large size made longitudinal strength vital. Longitudinal strength is provided by multiple bilge keelsons, a reinforced chine, and hogging trusses. Longitudinal interior bulkheads support the above decks.

Montana (1879) 959 Tons

	Sided	Moulded
Keel	N/A	N/A
Frames	6 inches	3.3 inches
Strakes	N/A	3 inches
Bilge Keelsons	9 inches	14 inches

TABLE II.1. Steamboat *Montana*'s scantlings (Corbin and Rodgers 2008:73-74).

The structural system is characterized by use of iron for trusses and fasteners. The availability of iron rods and turnbuckles by the 1850s is directly responsible for the development of this shipbuilding tradition (Willoughby 1999:71). In addition, iron fasteners require less time for unskilled workers to drive, as well as having a far stronger tensile strength (Bradley Rodgers 2009, pers. comm.; Gould 2000:5). The majority of steamboats were built in shipyards in Indiana and Pennsylvania until the 1860s, due to the availability of iron and the industrial infrastructure (Mueller 1990:102).

Lloyd's (1919) 900-Ton Frame-Based Ship Dimensions

	Sided	Moulded
Keel	15 inches	15 inches
Frames	14 inches	14 inches
Strakes	N/A	4.25 inches
Keelson	16 inches	16 inches

TABLE II.2. Frame-based ship scantlings required by Lloyd's Register (Desmond 1983:20).

The conceptual approach to constructing river steamboats diverged from frame and bottom-based construction as a response to local conditions and economic demands. The frames of this new type were underdeveloped for vessels of this scale, and the bottom lacked the strength to support itself. The primary longitudinal strength was provided by iron hogging trusses, a structural system that is neither frame-based nor bottom-based. A comparison of scantlings from frame-based ships and western river steamboats of the same tonnage, shown in Table II.1 and Table II.2, shows the primary structural timbers important to the frame-based conceptual approach have become too small in river steamboats to support the structure without hogging trusses. For example, a steamboat deposited in a field during a flood flexed with the landscape along its entire length. This flexibility was provided by the undersized scantlings and the vessel was refloated with little damage, returning to its normal shape by the tightening or loosening of turnbuckles (Hartford 1986). While the scantlings would not support ships of other shipbuilding traditions, western river steamboats were highly successful in their particular operating environment.

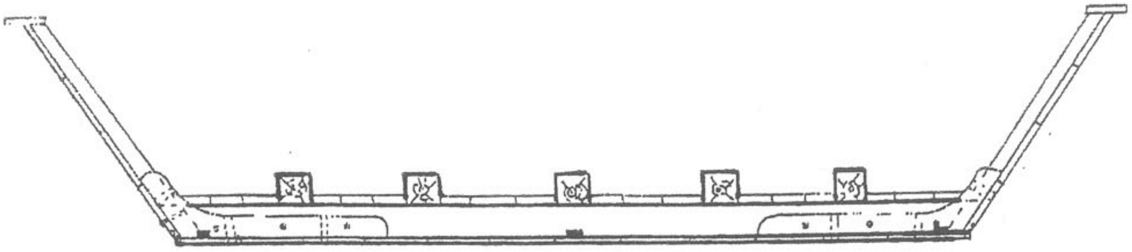

FIGURE II.6. Reconstructed cross section of the Old Sparta steamboat (Rodgers et al. 2008:56).

Following western river steamboats' success, their construction traits spread throughout the United States. One such steamboat sunk in the Tar River near Old Sparta, North Carolina, dating to the first half of the 19th century (Rodger et al. 2009:54). Figure II.6 shows the steamboat's reconstructed cross section, with a flat keelless bottom and angled sides. Bilge keelsons provide longitudinal support, but the ship's length suggests use of a hogging truss for its primary longitudinal component (Rodgers et al. 2009:59). The transition between the bottom and sides is strengthened by cocked hats attached to the floors (Rodgers et a. 2009:67). This structural system and scantling size is similar to those found in western river steamboats.

Bottom-Based Shipbuilding

The most recognized form of ship construction, to the average American, is frame-based, or ship-built, construction. Frames create a rigid structural system over which planking is placed to create a watertight vessel. Another form, called shell-first, was common in the ancient Mediterranean and used edge joined strakes to create a rigid shell, with frames added later as a secondary support system. A third ship construction method is bottom-based or bottom-built, first explicitly examined by Hocker (1991). Just as frame and shell construction are each distinct conceptual systems, bottom-based shipbuilding also approaches construction from a different cognitive model.

A major bottom-based tradition developed in Western Europe, but independent traditions might have been created in several other areas, such as Japan and North America. The European tradition developed along major rivers during Late Antiquity, with its earlier origins obscured in prehistory (Hocker 1991). Japan developed chine log coastal traders around the sixteenth century A.D. (Kimura 2008:11). Native Americans might have developed a bottom-based tradition by splitting dugouts (Hocker 1991:248). From these cultural nodes, and possibly others, bottom-based traditions spread and became commonplace throughout the world.

The term “bottom-based” describes both the method and product. The bottom is constructed first, such as frames in frame-based and the exterior in shell-based traditions. Once the bottom is finished, the remaining work is guided by its shape (Hocker 1993:21)

Hocker explains the general process in stating, “The distinguishing feature of this tradition is a heavy, flat bottom of straight planks, temporarily fastened together as the first stage of construction. After the bottom has been shaped, the temporary fastenings are replaced by heavy floor timbers and the sides completed” (Hocker 1991:iii). The bottom is therefore the strongest structural component in the ship and often distinct from the sides. This is fundamentally different from frame-based construction, where a keel is laid, the stem and sternpost are raised, frames are erected, and finally strakes are attached. Therefore, both assembly order and structural system indicate whether a ship is built bottom first.

Bottom-based craft are typically shallow draft, often used in rivers, sounds, or along the coast (Hocker 1991:iii). Due to the rigidity of the bottom, curvature is difficult though not uncommon. Therefore, bottom-built ships are often poor open ocean sailors. Developed inland and along the coasts of England, Germany, and the Netherlands, bottom-based vessels have typically maintained structural systems that function best in these environments. Where cultural practices intermingled, bottom-based ships often acquired outward traits or appearance similar to newer designs, while maintaining certain bottom-based traits (Hocker 1991:151).

There is a high level of variability in shipbuilding, as with many artifacts in the archaeological record (Schiffer and Skibo 1997:27). Many cultural groups use bottom-based shipbuilding with variability among sub-groups. Therefore the ideal gives way to practicality and innovation. While keels, curved bilges, and shared structure between the bottom and sides are not typically found on bottom-based vessels, they can occur where cultures overlap or develop due to the environment. The conceptual approach to construction is the proper distinguishing feature between traditions, shown through the assembly order and structural systems.

Colonists brought bottom-based construction to the New World along with the rest of their culture (Hocker 1991:220), though it could also have developed intuitively due to local conditions. Similar techniques are often found in different periods when conditions are similar (Gould 2000:96). While the ships that brought the colonists to the New World were frame-based, a slew of utility and small craft were built in a bottom-based manner, many times in a vernacular setting, parallel to the continuity seen in vernacular craft in Europe (Hocker 1991:150).

Bottom-based craft are often described as being built using “house carpentry” (Hocker 1991:224,252; Merriman 1997:75; Rodgers and Corbin 2003:222); making it unsurprising that vernacular shipbuilders would adopt such an accessible method. In particular, using the bottom’s shape to guide the rest of construction is far simpler than the complex whole moulding method of frame-based construction. In the Great Lakes, home-built scow schooners allowed farmers and local merchants to transport goods (Rodgers and Corbin 2003:211).

Landsmen throughout the United States did this as well, including Abraham Lincoln when he was a young flatboat merchant on the Sangamon River, shown in Figure II.7 (Piling 2009:155). The ease of bottom-based construction allowed a flexibility and liberalness not afforded by the complexities of frame-based construction, though the use of vernacular techniques are often regarded as inferior to traditional shipbuilding, referred to as “chump-built” (Eric Ray 2009, pers. comm.). The infusion of many vernacular techniques and qualities in bottom-based vessels creates traditions that are difficult to trace archaeologically.

FIGURE II.7. Abraham Lincoln constructing a flatboat (Piling 2009:155).

The American South

The historical record indicates the most common vessel in the colonial Southeast is the bottom-based periauger, also called periagua, pereaugur, or piragua (Fleetwood 1995:31). A simple craft, the periauger was a dugout split in two, creating chine logs. Between these chine logs was a single plank to increase beam. The earliest and most descriptive account is by Thomas Lawson, who traveled through the Carolinas before 1710. Lawson described a group of Frenchmen building a periauger, “after the tree is moulded and dug, they saw them into two Pieces, and so put a Plank between, and a small keel…" (Lawson 1710:97). This technique might be a hybrid of native and European (Fleetwood 1995:31); however, both French and Spanish settlers might have known this construction from France (Pecorelli et al. 1996:22-28). Further supporting the European origin of the split dugout, no pre-contact boat shows evidence of a supplementary central plank. After European contact, a number of split dugouts are found, similar to Figure II.8 (Newsom and Purdy 1990:172). Despite its widespread use, nothing has been found in the archaeological record that is conclusively a periauger.

FIGURE II.8. A post-contact split dugout from Florida (Newsom and Purdy 1990:173).

The archaeological record does show a strong tradition of bottom-based shipbuilding taking root. An examination of the Trent River flat (Alford 1991), the Brown's Ferry vessel (Hocker 1991; Amer and Hocker 1995), the Cypress Landing scow schooner (Merriman 1997), the Pasquotank River barges (Smith 2010), and the unpublished Mars Bluff skiff, shows separate types of Southern utilitarian bottom-based vessels spanning the 18th to 20th centuries.

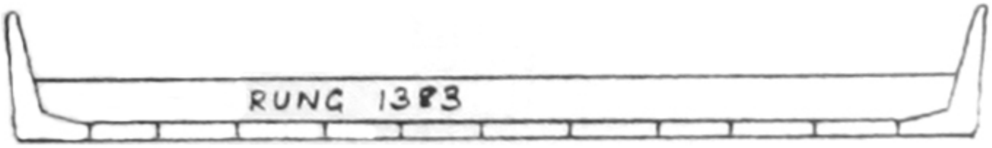

FIGURE II.9. The Trent River flatboat's cross section, showing L-shaped chine logs (Alford 1991:13).

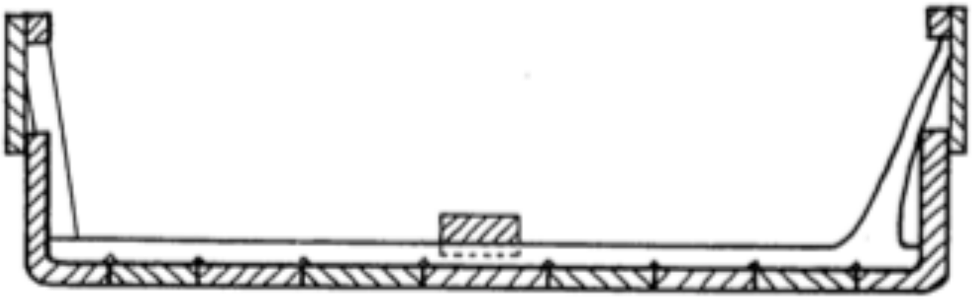

FIGURE II.10. The Zwammerdam barge's cross section, showing L-shaped bilge strakes (Hocker 1991:52).

The Trent River flat is the earliest, dating to the 1720s (Paul Fontenoy 2009, pers. comm.). Found near the confluence of the Trent and Neuse rivers at New Bern, North Carolina, the vessel shows a sophisticated bottom-based technique, indicating experienced shipbuilders transferred the method to the area. The boat is thirty-one feet (9.45m) long and eleven feet (3.35m) wide, likely used as a ferry. Lacking a keel, the vessel's sole longitudinal support comes from the two chine logs. The logs are L-shaped in cross section, similar to the chine girders or bilge strakes on the Roman Zwammerdam 2 barge, shown in Figures II.9 and II.10 (Hocker 1991:52). This creates a strong turn of the bilge and allows a good attachment point for the frames. Planks run longitudinally to create the bottom.

Flats are an important vessel type since they function within limited conditions. While some boat types have changed dramatically through time, flats' design and construction have stayed remarkably stable (Alford 1991:12). Therefore, the presence of this flat clearly illustrates a European tradition rather than local innovation. The sophistication of the chine log shows a highly developed tradition. Importantly, dugouts might be the origin of bottom-based construction (Hocker 1991:257), and a chine log is essentially a split dugout.

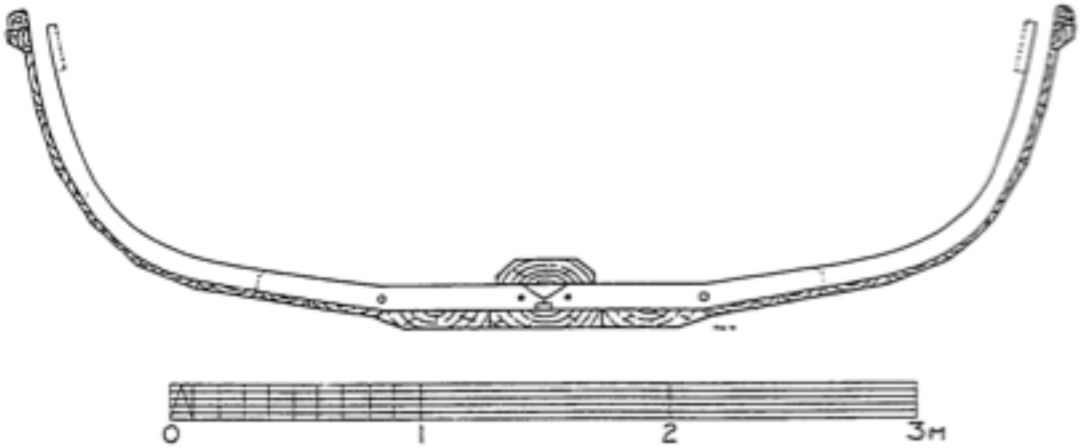

FIGURE II.11. The Brown's Ferry vessel with three planks forming the bottom (Hocker 1991:233).

Dating to the mid-18th century, the Brown's Ferry vessel is the best documented Southern bottom-based boat. Measuring fifty feet (15.25m) long and fourteen feet (4.25m) in beam, the vessel was found near Georgetown, South Carolina (Hocker 1991:227-228; Steffy 2006:162). Lacking a keel, the vessel was constructed using three heavy planks to create the bottom, shown in Figure II.11, the main longitudinal component. The stem and sternpost were then added directly to the planks, along with frames for moulding.

A high level of craftsmanship was used in building this vessel. While bottom-based, sophisticated whole-moulding was used to creating the framing. Hocker suggests it is an evolved form of the periauger, possibly integrating European and native traditions (Amer and Hocker 1995:298). A Davis quadrant, an ocean navigation tool, suggests it was used beyond the river's confines (Hocker 1991:228). The ship indicates skilled colonial shipbuilders were using bottom-based techniques in the middle of the 18th century.

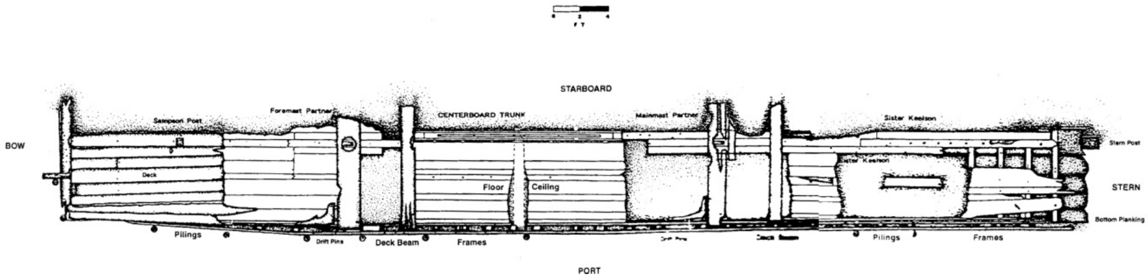

FIGURE II.12. The Cypress Landing scow schooner site plan (Merriman 1997:17).

The Cypress Landing vessel is a scow schooner, located in Chocowinity Bay, North Carolina. Dating from the mid to late 19th century, it features traditional scow construction, measuring seventy-three feet (22.25m) long and fourteen feet (4.26m) wide, with a draft of 27.25 inches (0.7m). The site plan is shown in Figure II.12. The ship has a flat bottom and straight sides, with a transom bow and stern. The vessel's long, narrow shape is, possibly, indicative of use in the Chesapeake and Albemarle or Dismal Swamp canals (Merriman 1997:75). The scow was propelled by sail and stabilized with a centerboard, probably for sailing to Edenton and Washington, North Carolina, after exiting the canals. The vessel was used as a bulk carrier, the traditional use of scow schooners (Merriman 1997:34-35).

Scows are one of the most popular bottom-based ships in North America (Merriman 1997; Rodgers and Corbin 2003). Developed since the 1670s, the oldest known scow dates to 1743 (Merriman 1997:33,34). The schouw is the traditional boat of the southern Netherlands, suggesting Dutch settlers introduced them to the colonies, though the modern scow differs in form to the Dutch schouw. Simple to construct, scows were used as utility vessels on every major river, also spreading from the Atlantic to the Pacific and the Gulf of Mexico. Scows became immediately popular on the Great Lakes after *Bolivar,* built in Erie, Pennsylvania, was introduced in 1825 (Merriman 1997:34). Scow schooners were common until the 1970s.

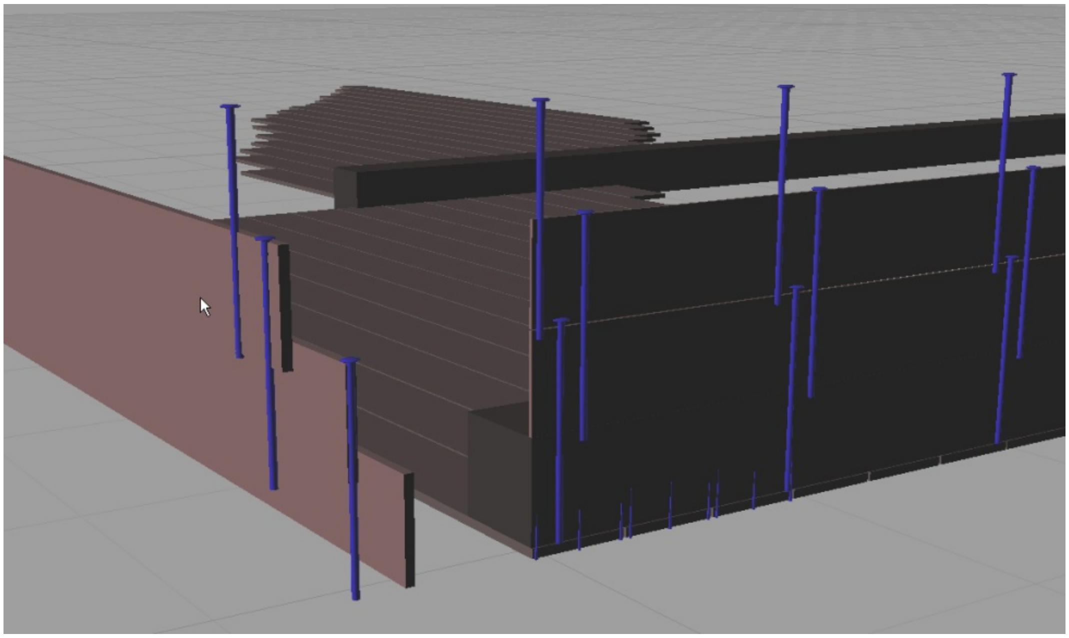

FIGURE II.13. Isometric view the fastening pattern on barge 0051PQR (Graphic by author, 2009).

Abandoned barge 0051PQR in the Pasquotank River is part of the Elizabeth City, North Carolina, Dismal Swamp Canal abandonment assemblage (Smith in Prep.). Dating from the late 19th century to the early 20th century, the barge or flatboat is 12.33 meters long and 6.43 meters in beam, with a one meter draft. Chine logs and regularly spaced keelsons provide longitudinal strength, depicted in Figure II.13. The barge is heavily built using crude or simple techniques, including bottom strakes that are roughly cut. These strakes extend beyond the chine log in an uneven fashion, suggesting they were cut with little concern after the chine was attached to them. The side strakes are attached to the chine logs by alternating iron fasteners, called drifts. Each drift is blindly driven through the target timber and then through the preceding one. With the addition of more strakes, an alternating pattern is achieved, resulting in each strake being pierced by two sets of drifts.

Amateurs recovered the Mars Bluff skiff under a South Carolina intensive survey license. No published reports have addressed this unremarkable craft that is housed in the Myrtle Beach Indoor Shooting Range. A small skiff from the late 19th or early 20th century, the extant remains are thirteen feet (3.96m) in length with a four foot (1.22m) beam. Reconstructed, the vessel was likely fourteen feet (4.27m) long. Built upside down, the bottom is composed of two planks a half inch (1.3cm) thick. The bottom was likely laid down as a panel and cut to shape, as seen in Figure II.14, a common feature in North American bottom-based construction (Hocker 1991: 223). The frames are spaced a foot (30.5cm) apart, measuring an inch (2.5cm) sided and moulded, with the nails, driven from below, clinched back over into the frame. A chine timber transitions between the two bottom planks and the now missing strakes. Attached both from the bottom and athwartships to the bottom planks, this timber is 1.5 inches (3.8cm) sided and a half inch (1.3cm) moulded. The bow is gently rockered. The entire bottom and interior is covered in tar to make it watertight.

This simple craft required little skill to construct and was useful for a range of activity. Its context suggests it was used in conjunction with the logging industry and is evidence of continued bottom-based construction into the 20th century. Non-traditional methods often survive in small craft, such as a clinker boat in Maryland (Neyland 1990); use of medieval "rising and narrowing" in France, Greece, and Brazil in the 20th century (Rieth 1996), and bottom-based construction featuring temporary cleats in 20th century Netherlands (Hocker 1991:178). It is therefore not surprising that many examples of Southern bottom-based construction are small craft, such as the Mars Bluff skiff.

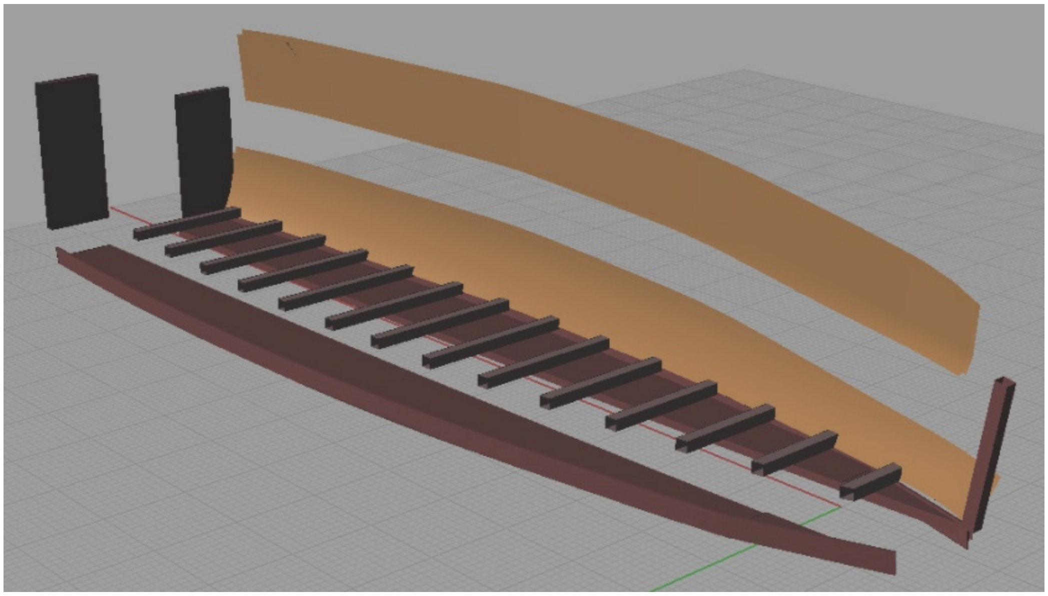

FIGURE II.14. Isometric view of the Mars Bluff skiff's construction features (Graphic by author, 2009).

As colonists arrived in North America and moved westward, they brought their material culture with them. In similar environments, the culture was identical, such as the Trent River Flat. In other cases, where conditions prohibited exact replication, adaptability turned European traditions into hybrid vessels such as the Brown's Ferry vessel. North America incorporated traditions from many parts of Europe. John Lawson and William Dampier's accounts describe multinational people throughout the colonies (Lawson 1710:96; Preston and Preston 2004:33). Besides the Frenchmen in North Carolina noted by Lawson, the city of New Bern was a Swiss and German settlement founded on the mouth of the Neuse River in 1710 (Graffenried 1920).

Navies Before the Civil War

Bottom-based vessels are limited due to their shallow draft, so bottom-based shipbuilding is not typically found in navies. There are, of course, several distinct exceptions. Rome utilized bottom-based craft to support their legions exerting power on rivers like the Rhine during Late Antiquity (Hocker 1991:54). Dutch warships were popular in Europe until the 18th century, when frame-based shipbuilding took pre-eminence. During the American Revolution, French and Indian War, and the War of 1812, periaugers, galleys, and bateaux were used in assaults on coastal and riverside targets (Fleetwood 1995:32,74; Starbuck 1999:188). Carrying as many as forty soldiers, these vessels were not commissioned warships, but adopted for specific missions. During the Revolutionary War, commissioned gundalows on Lake Champlain, including the gunboat *Philadelphia*, were bottom-based (Hocker 1991: 224).

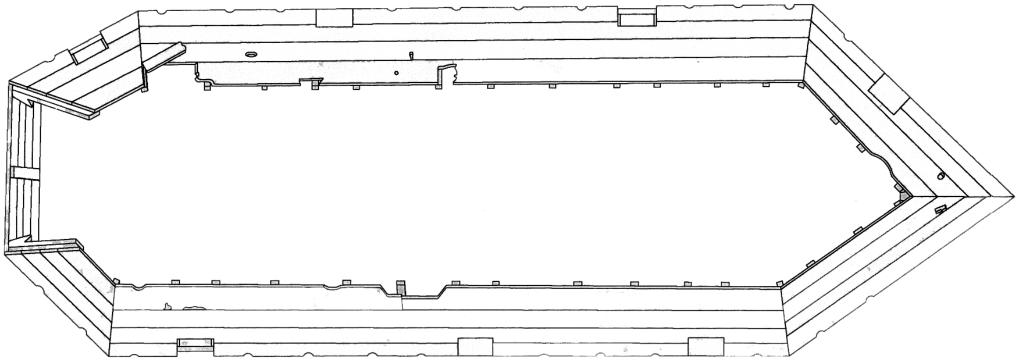

FIGURE II.15. Plan view of *Land Tortoise*'s casemate (Starbuck 1999:189).

An interesting parallel exists between British radeaux from the French and Indian War and later Civil War shallow drafted vessels. *Land Tortoise* is an excellently preserved radeaux sunk in Lake George, New York, in 1758. Used as floating batteries, the radeaux featured seven sided wooden embrasured casemates, as shown in Figure II.15. Fifty-two feet (15.85m) in length and eighteen feet (5.49m) in beam, the radeau used a single mast. *Land Tortoise* had seven gun ports as well as twenty-six sweep holes for small arms.

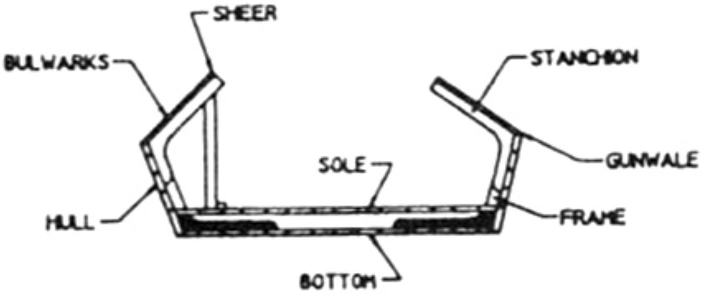

FIGURE II.16. Cross section of *Land Tortoise*, showing a flat bottom and sharp chine (Starbuck 1999:189).

The flat "raft" like design, in Figure II.16, is bottom-based (Starbuck 1999:187). The flat bottom was laid like a panel, connected by floors. At the chine, frames overlap the floors to strengthen the transition, shown in Figure II.17. Top-timbers serve the same function at the knuckle. Longitudinal strength is provided by the bottom strakes and, possibly, by the ceiling on top of the floors. This gunboat is likely the product of the English bottom-based tradition.

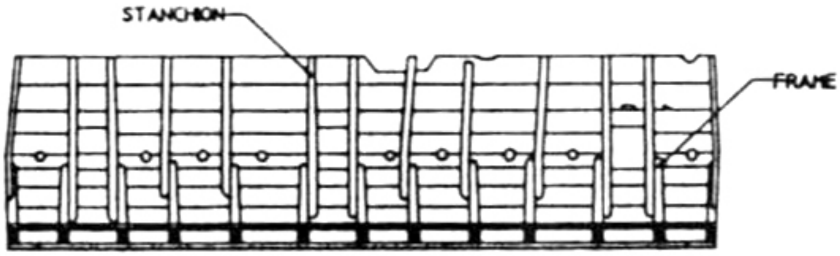

FIGURE II.17. Framing pattern on *Land Tortoise* (Starbuck 1999:189).

The first significant 19th century naval use of bottom-based construction was the French and British floating batteries during the Crimean War. The early English ironclads had nearly flat keelless bottoms, shown in Figure II.18. Longitudinal strength was provided by a keelson and six bilge keelsons, as well as a reinforced chine, or bilge, assembly (Holcombe 1993:5). Though the Crimean batteries led directly to the development of armored warships, such as *Warrior*, launched four and a half months before the start of the Civil War, later British and French ironclads were constructed using the frame-based conceptual approach. Bottom-based construction was not used for ironclads again until the experimental vessels of the Civil War.

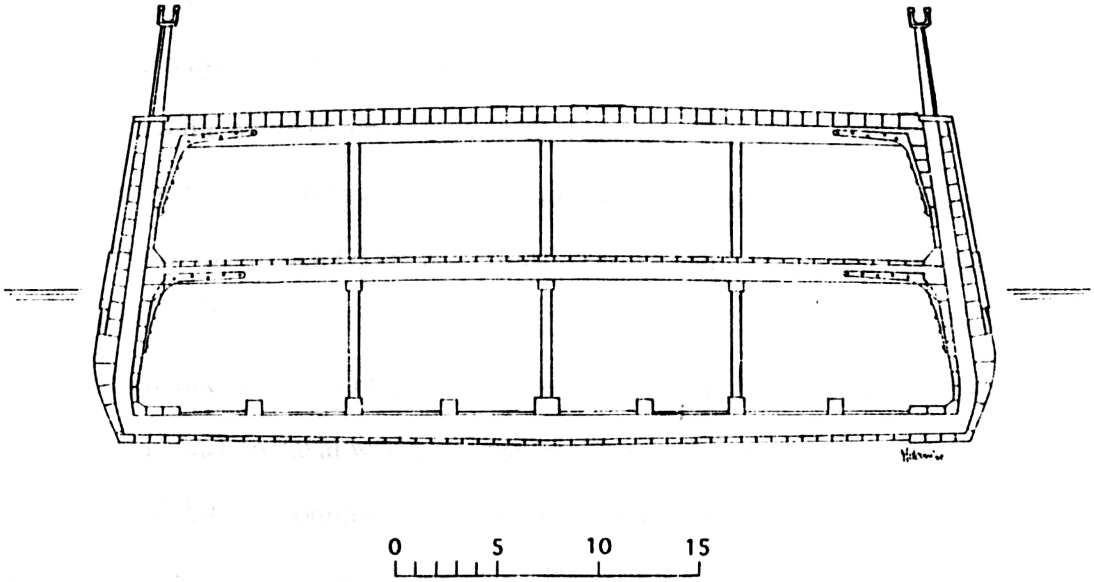

FIGURE II.18. Construction features on the British Crimean floating batteries (Holcombe 1993:5).

Civil War Navies

The first ironclads built during the war were the Union city-class, including USS *Cairo*, raised from the Yazoo River in the 1960s (McGrath and Ashley 1981). Flat bottomed and powered by a center paddlewheel, Alfred Mahan likened their construction to scows (Mahan 1883:14). The ironclads utilized multiple keelplanks along with cocked hats in between frame pairs to strengthen the chine and knuckle. Stingers and clamps, listed as the "shelf" in Figure II.19, further support the chine and knuckle. The city-class design and construction resemble the later Confederate *Missouri*-class, such as *Jackson*. Other warships, such as USS *Essex* and USS *Indianola*, appear bottom-based.

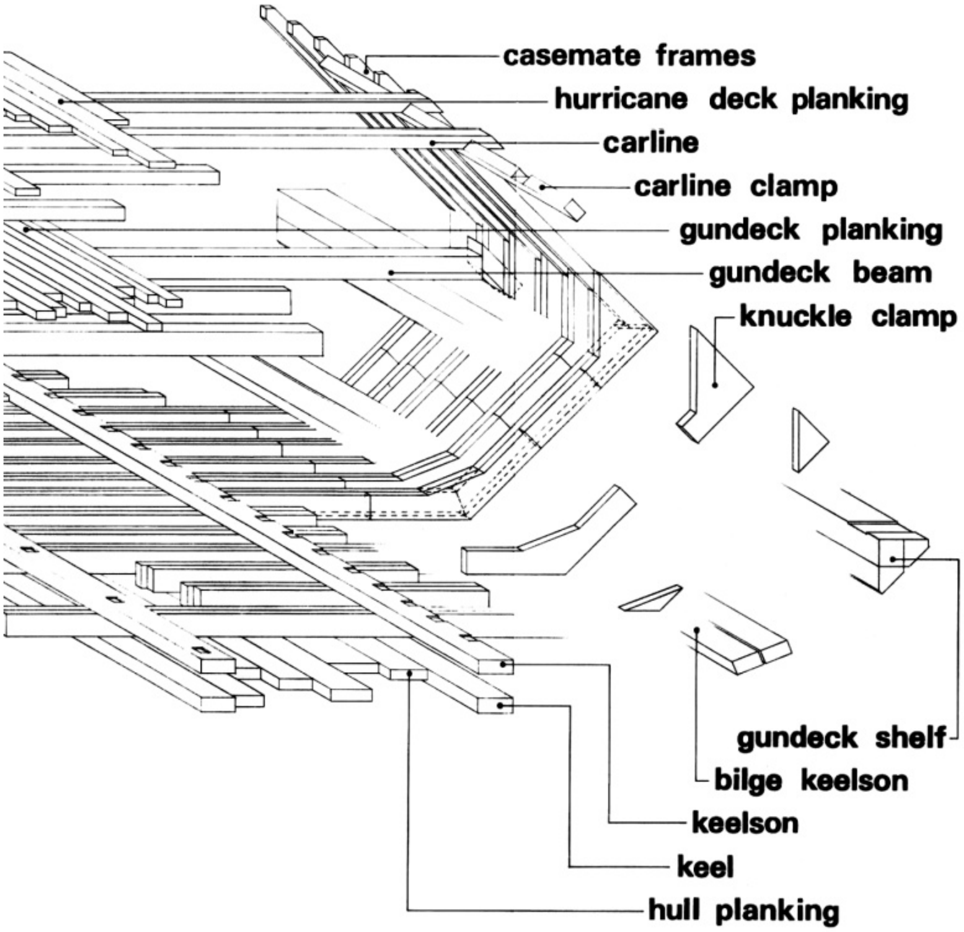

FIGURE II.19. Isometric view of *Cairo*'s construction features (McGrath and Ashley 1981:42).

The Union also produced iron bottom-based ships contrary to the claim that "the wooden ship and the iron ship reflect distinctly different historical contexts and concomitant technological, economic, and social processes," especially the various Civil War ironclads (Garrison 1995:26). USS *Monitor* is the first example.

John Eriksson was likely cognizant of a bottom-based tradition, having grown to adulthood and worked on Sweden's Grota Canal, as shallow draft canal boats are typically bottom-based (Church 1911:21). He had extensive experience building canal boats, including several in England and the United States (Church 1911:99,113). He constructed six between 1836-1839 and his 1837 vessel was fitted with his first propeller (Church 1911:99-100). *Monitor* was required quickly, so Ericsson devised a strategy for easy assemblage, chiefly using flat iron pieces, similar to the Confederate wooden shipbuilding program. The ship was not built bottom first purely for quick assembly, since the ironclad Ericsson designed for Napoleon III in 1854 is also bottom-based (Peterkin 1985:42-43). In *Scientific American*, Ericsson described his design.

> The structure consists of three principal parts, viz., a shallow-decked vessel with perpendicular sides, dead flat bottom and pointed ends. Under this shallow vessel a second and deeper vessel is attached with a raking stem and stern, perfectly flat bottom and sides inclined at an angle of 51[degrees] to the vertical line. This lower vessel does not extend the entire length or breadth of the upper one (Ericsson 1861:331).

Each section was built individually and assembled later, including the "third part," the turret. To construct the "deeper vessel," the bottom plates were laid and fastened together. The base was completed before the side plates even arrived (Watts 1975:77). The builder's half model shows the bottom plates to be distinct from the sides and guiding the ship's shape, as shown in Figure II.20. Lacking a stem, sternpost, or keel, the bottom plates form the ship's sole longitudinal component (Peterkin 1984:3). Floors, measuring three inches (7.6cm) sided by six inches (15.2cm) moulded, were attached athwartships, connected with frames and stanchions to anchor the "shallow-deck vessel" to the deeper vessel (Canney 1998:31). The two bulkheads supporting the turret were also fastened into the bottom. Though using iron, the method of construction and structural systems are in the bottom-based tradition. *Monitor*'s performance in the open ocean is akin to other shallow drafted bottom-based vessels. Interestingly, the later monitors, such as the *Passaic*-class, are frame-based ships with a curved bilge and fine lines (Canney 1993:76).

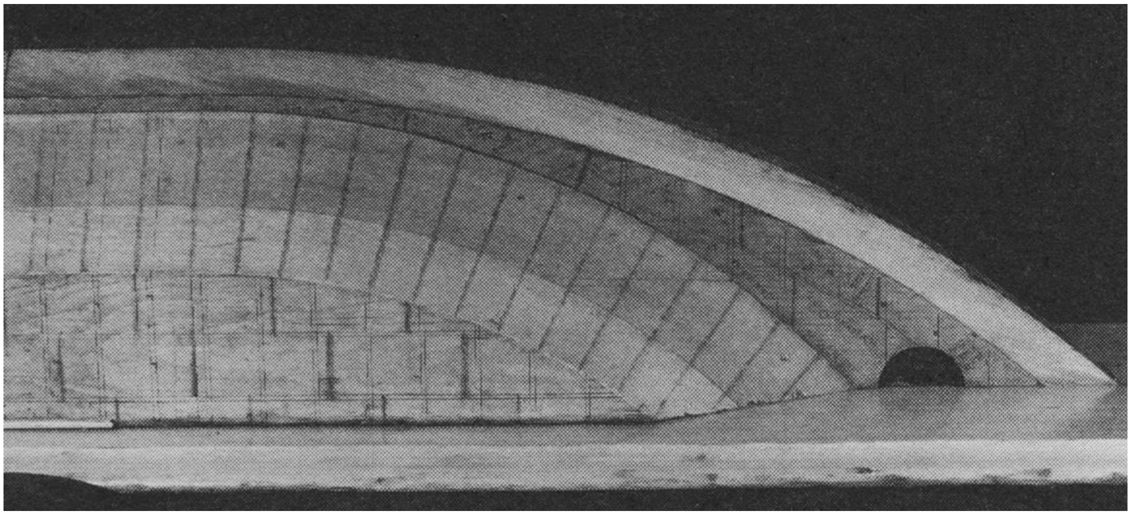

FIGURE II.20. The original builder's half model showing that *Monitor*'s bottom is distinct from its sides (Canney 1993:30).

It is difficult to know the number of bottom-based ships built within the Confederacy due to the decentralized shipbuilding program. While Porter's designs appear to be frame-based, archaeological evidence shows contractors executed his design using bottom-based methods. A number of ironclads appear to be bottom-based, including *Mississippi* and, possibly, *Georgia,* which was built on stocks with no keel and a barge-like construction (Watts 2006:12,65). Unfortunately, wooden elements on *Georgia* have disintegrated (Watts 2006:5). The construction plans for *Tuscaloosa* and *Huntsville* bear a resemblance to the bottom-based western river steamboat tradition (Holcombe 1993:96; Kane 2004:101).

Conclusion

Tracing traditions is difficult, as “origins, continuity, and cultural affiliation” have to be proven (Hocker 1991:252). Maritime archaeology is a young field still developing assemblage databases for comparative analysis. Scholarly works are heavily biased toward ancient Mediterranean and Age of Sail vessels rather than North American inland craft (Rodgers et al. 2009:54). The four influences outlined in this chapter are the pre-war conceptual traditions with traits identifiable in wartime ships, but the origins of the traditions and their continuity are less than definitive. Furthermore, Porter’s design, vernacular traditions, western river steamboats, and bottom-based shipbuilding were not mutually exclusive. They coexisted together for years prior to the war, allowing concepts to intermingle.

Porter incorporated a flat bottom, possibly from interaction with river craft like western river steamboats. Two western river steamboat construction methods are bottom-based, and the form may have been developed from earlier bottom built designs. Bottom-based construction can be intuitively developed, a form of local innovation. Gunboat designs in the 19th century were highly variable. As designers attempted to merge floating batteries with operating conditions, naval constructors used innovation and vernacular ideas familiar to them. Therefore, the four influences interacted with one another and, indeed, variants of each tradition are found together in some vessels. Nevertheless, each shows distinct features in shipbuilding, allowing analysis. An examination of the diamond hull ironclads *Neuse* and *Jackson* shows how four traditions influenced construction.

CHAPTER 3: CSS *NEUSE*

On 17 October 1862, the Confederate States' Navy signed a contract with New Bern shipbuilders Thomas Howard and Elijah Ellis for an *Albemarle*-class ironclad to be built in Whitehall, North Carolina (Bright et al. 1981:6). A small town on the Neuse River, Whitehall is twenty-four miles upstream from Kinston, where a local naval station was created (Popp 1872:736). Whitehall and Kinston were carefully chosen. Wood was collected upstream of Whitehall, while its inland location offered protection from Union raids. Kinston had a railroad crossing and also marks the river's change from an average depth of 4.5 feet (1.37m) to five feet (1.52m), which the navy hoped would be deep enough for a loaded ironclad during a freshet, depicted in Figure III.1 (Popp 1872:736). The completed wooden hull was to be handed over to the government on 1 March 1863, after which it would be fitted with engines and armament in Kinston, increasing its draft. Soldiers, carpenters, and shipwrights were brought to Whitehall and the keel was laid in November 1862 (Still 1966:2).

Construction nearly ceased 15 December 1862, when a Union raiding party partially destroyed the vessel on the stocks. Union forces claimed the gunboat was destroyed, though shipbuilders were able to repair and finish the vessel. The unpowered wooden hull was poled downstream and delivered to the Kinston naval station by May 1863 (Bright et al. 1981:8). The river has dangerous rapids four miles below Whitehall, called the "Let Lones," but this navigation hazard does not appear to have hindered the gunboat's delivery (Popp 1872:736). Despite the Union attack, the ship was only a month overdue. Construction had taken between five to six months.

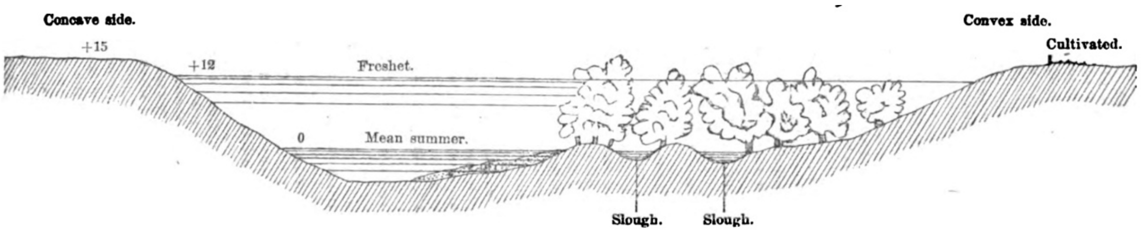

FIGURE III.1. Neuse River cross section, showing the mean and freshet water levels (Popp 1872:736).

Once in Kinston, the hull was moored to be fitted out (Bright et al. 1981:9). The ship was christened CSS *Neuse* some time around November 1863, since Richard Bacot refers to the gunboat by name in his letters (Bacot 1865). This period is marked by an onslaught of problems. In fact, the vessel experienced so many difficulties that Bacot called the ironclad the "Neus'ance" (Bacot 1865 3B:March 19). Fortunately, he also sketched the only contemporary image of the vessel, Figure III.2. Carpenters began working on interior bulkheads over the summer, but a large cargo of wood was lost when the barge carrying it overturned. An expensive cofferdam was built to cut the propeller shaft holes, a costly oversight by the Whitehall carpenters (Cooke 1863:1). This cofferdam was likely fitted over the stern, similar to the one described by George Gift for repairing *Chattahoochee* (Gift 1863: February 17).

All material delivered by rail was delayed, with iron plate constantly postponed. Governor Zebulon Vance allowed North Carolina railroad iron to be rolled into plate, provided it was used for the *Neuse*. The rails were sent to Atlanta, though Richmond and Selma also rolled two-inch plate (Still 1966:4, 1971:8,44,192). Once a shipment was ready to be moved from Atlanta to North Carolina, the navy had to wait for the army's permission to use the railroad. The plates were drilled by the Hart and Bailey company in Wilmington (Still 2008:45). Six months after the ship left Whitehall, interior bulkheads and some iron plating were in place, but it was still missing its engines, boiler, and propellers (Still 1966:5). Machinery faced the same delays; the engines arrived in February 1864, likely from the Schockoe Factory in Richmond, via Goldsboro (Still 1966:5). Once in Kinston, the machinery installation was overseen by experienced engineer Thomas Carr, who also installed the machinery on *Albemarle* (Still 2008:33). Confederate leadership was desperate to get *Neuse* and *Albemarle* into action and to recapture New Bern and Plymouth.

FIGURE III.2. Richard Bacot's drawing of *Neuse* (Bacot 1865 3B:March 19).

Historical reports show a number of skilled shipbuilders worked on *Neuse* in Kinston. In addition to local workers, nineteen from the Mars Bluff naval station on the Pee Dee River and four from Wilmington were present, suggesting that skilled workers were temporarily transferred from station to station (Minor 1864:Feburary 16). This large skilled crew suggests that the skill level must correlate to an equally skilled product (Still 1971:192). This hypothesis is logical, but not always true. These particular shipbuilders in Kinston were under the aegis of the Navy Department, fitting out *Neuse* with machinery, interior bulkheads, and its casemate. The Whitehall contractors, with an unknown skill level, had long since completed the basic structure.

On 22 April 1864, *Neuse* received its first orders and was sent to aid an assault on New Bern, fifty miles below Kinston (Popp 1872:736). Unfortunately, the ironclad ran aground on a sand bar approximately a half-mile below Kinston (White 1864:5), a known navigation hazard that is the shallowest bar below the naval station (Popp 1872:737). A Union chaplain interred in the local prison witnessed the grounding,

> The whistle was blown, the bell was rung, and with a full head of steam, with the rapid current (for the river was then high) she moved down the Neuse. She drew eight feet of water. The pilot did not know the channel, and supposed he had more water than he had. She had not gone half a mile before she got to the right of the channel, and with full speed ran on a bar of clay and sand, and such was her speed that she ran her horn forty feet into the bar, where she struck fast (White 1864:5).

The officers worried that the falling water level would break the ship's back, but the water rose enough to refloat *Neuse* in mid-May (Bright et al. 1981:14). The ironclad returned to Kinston, where work began again, likely lessening its draft. The vessel missed its best opportunity to head down river during a freshet due to repairs. A long period of inactivity appears to have followed, though sources from the fall of 1864 are scarce.

Wilmington, the crucial port of the Confederacy, fell on 22 February 1865 (Bright et al. 1981:17). Union forces followed the victory with incursions into North Carolina's interior. On March 7, Major General Cox arrived at Wyse Fork, south of Kinston, and the junction of the New Bern and Goldsboro Railroad (Still 1971:221). Union troops reached Kinston's outskirts on 12 March 1865. *Neuse*'s crew was ordered to cover the army's retreat and then to destroy the ship to prevent capture.

Neuse steamed downstream until it encountered Union cavalry. After firing salvos of grape and canister shot, the gunboat returned upriver and the crew abandoned ship (Martin 1996:48; Bright et al. 1981:17). The two cannon were spiked, a charge was set in the hold, and the gunboat was set afire. The charge was intended to destroy the ship, but it only blew a hole through the port bow, flooding the ironclad and extinguishing much of the fire (Still 1966:12). Local tradition claims the fire ignited a shell lodged in a cannon, blowing the hole (Morris Bass 2008, pers. comm.). This is unlikely as the cannon were more likely loaded with canister and grape shot from their recent encounter, if loaded at all. Furthermore, decking was intact until the 1960s, as shown in Figures III.3 and III.4. Instead, the charge was likely set in or near the forward cooking stove based on the stove fragments relative to the explosion hole (Morris Bass 2008, pers. comm.). The ship came to rest along the riverbank immediately below Kinston, with its bow upstream. The ironclad settled bow first, and the burn pattern shows the stern continued to burn for some time.

Neuse remained fairly complete, though sunk. The United States government ignored the vessel until July 1865, when acting governor William Holden wrote the treasury department about the vessel. Stating its value was likely around $500, he offered to purchase the hulk. The Secretary of the Treasury forwarded Holden’s letter to New Bern treasury representative William Heaton, who recognized the value of the ironclad. Taking it upon himself, Heaton auctioned the vessel on 9 October 1865 for $3,500 to the New York firm of Satterlee & Lyon (National Archives 56[14]:189). The auction advertisement lists items of interest including two engines, a donkey engine, a boiler, 250 tons of iron, twenty tons of coal, and three anchors with chains (*North Carolina Gazette* 1865:1).

The initial salvage stripped the ironclad of nearly everything useful, damaging *Neuse*'s structure in the process. The armor plating was removed, followed by the casemate. The casemate was thrown into the river beside the ship to gain access to the engines and boiler. The boiler was possibly sold to J.F. Parrot for his local sawmill, the only steam sawmill on the river after the war (Popp 1872:739; Bright et al. 1981:9). Propellers and their shafts were removed, destroying the stern.

FIGURE III.3. *Neuse* on the day salvage began in 1960 (Courtesy of the William H. Rowland Papers, Joyner Library, East Carolina University, Greenville, NC).

Treasury Department salvage contracts were commonplace immediately following the war. The Department searched for any former Confederate property to raise revenue. In Wilmington, the scuttled wooden gunboat *Yadkin* was raised, refitted, and sold (*Daily Journal* 1867:1). *North Carolina*'s armor plating was removed and sold at public auction (*Wilmington Star* 1871:1; Reeves 1978:282). Salvage contracts were signed for the diamond-type ironclads *Jackson*, *Fredericksburg*, *Huntsville*, and *Tuscaloosa*, but not every contract was fulfilled (National Archives 56[175]).

Local salvage often continued on many vessels through the 20th century. Between 1865 and 1958, there was periodic small-scale salvage of *Neuse*. The best documented is the recovery of three Brooke projectiles by several young boys (*Kinston Free Press* 1961:12). While swimming near the site, the boys pulled artifacts from the ship and brought them into town, rekindling interest in *Neuse*.

FIGURE III.4. Photograph of the decks cleared during salvage (Courtesy of the William H. Rowland Papers, Joyner Library, East Carolina University, Greenville, NC).

The initial salvage caused considerable damage, but the Civil War Centennial efforts destroyed the vessel. In 1960, a partnership of three local men, Henry Clay Casey, Lemuel Houston, and Thomas Carlyle, attempted to salvage the vessel, believing it contained profitable goods. During low water, a dragline was used to constructed a cofferdam and begin recovery. Photographs show the vessel was nearly intact from the deck down, with the exception of the badly damaged stern. Over the next four years, the men and an army of volunteers unearthed the ironclad.

With no archaeologist present, the site was irreparably damaged due to a widespread belief in valuable cargo or relics. More interested in artifacts than ship's structure, many timbers were removed and discarded, either dumped in the river or burned. As a result, the casemate remnants, decking, bulkheads, and sternpost were lost. The context for the remaining associated artifacts was also lost, squandering incalculable amounts of information about Confederate shipbuilding and shipboard life.

The ship's remains, now simply the bottom and portions of the sides, was dragged onto the riverbank and cut into three sections. The sections were relocated to the nearby Governor Caswell memorial. Public interest led to creating an outdoor museum, but there were individuals who wished to dispose of the vessel by fire. A local Civil War enthusiast who had volunteered during the salvage, William Rowland, recorded the remains before they could be harmed. This research represents the first methodical investigation of *Neuse*. Fortunately, the newly formed North Carolina Underwater Archaeology Branch's Leslie Bright researched the ironclad a few years later. Bright, Rowland, and James Bardon eventually published an historical account and description of the remains, as well as an artifact catalog (Bright et al. 1981).

The ship remained outdoors for many years, damaged by harsh environmental conditions, biological attacks, poorly advised conservation attempts, and further damage from relic hunters. Today, the vessel sits in the Caswell Memorial State Historic Site, Figure III.5, covered by a roof, but exposed on the sides. Listed on the National Register of Historic Places, the ship has increased protection, but small damage continues from time to time due to tourists. There are currently plans and funding to move the gunboat to a new, temperature-regulated museum in downtown Kinston.

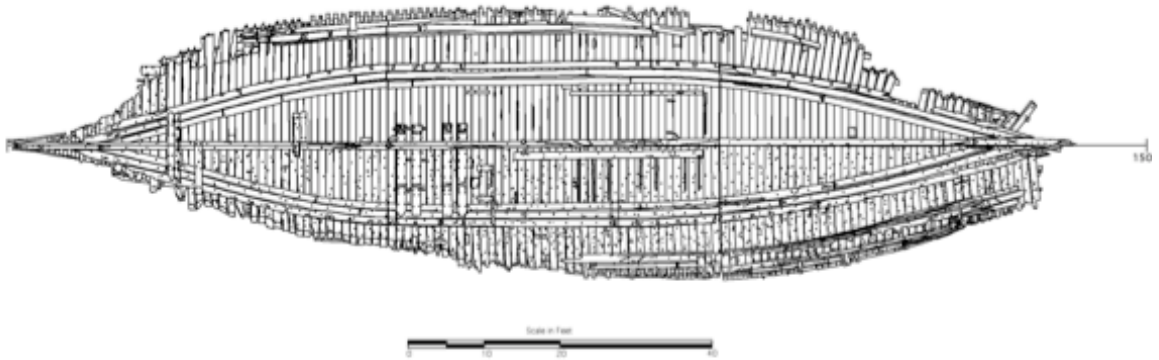

FIGURE III.5. *Neuse*'s condition today following 144 years of salvage and site formation (Watts 2006:14).

Dimensions

A copy of Porter's sketchbook, including scaled plans for *Neuse* and *Albemarle*, is located in Joyner Library's Special Collections at East Carolina University (Porter 1862b). The plans are general, simply listing major measurements and indentifying a few timbers. Construction plans fit Howard Chapelle's definition of "original design" plans, unreliable since changes and alteration are nearly always required during construction (Chapelle 1951). The length between perpendiculars is listed as 152 feet (46.33m) and the extreme beam is thirty-four feet (10.36m). The draft is listed as six and half feet (1.98m), while the "Depth to lower edge of Rabbet on bottom," or depth of hold, is nine feet (2.74m) (Porter 1862b:5). The extant structure differs from the plans in a number of ways, but the general measurements are similar.

The extant structure is 140 feet (42.67m) long overall and thirty-five feet (10.67m) in extreme beam. The height is nine feet (2.74m). The vessel remains are primarily from below the waterline, with small sections of the knuckle, once flush with the decking, and a six-foot (1.83m) section of the casemate. Despite many missing sections, enough remains to create an accurate reconstruction.

Reconstructed, *Neuse*'s length between perpendiculars is 136 feet (42m), with a length on deck of 150 feet (45.72m). The length overall, including the ram, is 158 feet (48.16m). The gunboat's moulded beam is thirty-four feet (10.36m), with a thirty-six foot (10.97m) extreme beam. The depth of hold, from the rabbet to decking, is nine feet (2.7m). Meant to ride low in the water to decrease exposed surface area, the loaded draft would have been slightly less than depth of hold, approximately seven and half to eight feet (2.28m). Benjamin Loyall lamented that *Neuse* "will draw nearly 8 feet [2.44m] of water when complete" (Bright et al. 1981:14). Significantly deeper than Porter's projection of six and half feet (1.98m), the ironclad would require a freshet to make it downstream.

Porter lists the ship's planned tonnage as 4376 (Porter 1862b:5); but he was perhaps referring to volume, since this number differs greatly from the *Neuse*'s actual displacement. If calculated from the extant structure, the *Neuse*'s displacement is approximately 1031.9 short tons. The ship's gross tonnage, or internal volume, is 280 tons, with a net tonnage, or carrying capacity, of 177 tons, calculated from the ship's general dimensions. With ninety-four crew members, *Neuse* has a tons-per-man ratio of 10.9:1. This figure is indicative of early ironclads. Sailing vessels typically had a ratio of 100:1, but the combination of sailors and mechanics required for steamships decreased the ratio to between 5 to 9:1 (Gould 2006:288). *Gloire*, for example, had a ratio of 10:1, while *Warrior* was 13:1.

Neuse's two horizontal direct acting engines were built in the Schockoe Foundry in Richmond, similar to those built for *Raleigh* (Still 1971:101n; Peebles 1996:31). The engine blocks remain, resembling *Chattahoochee*'s, though *Neuse*'s blocks are parallel instead of opposed (Watts et al. 1990:45). The engines could generate eighty horsepower, but they were fed by a single fifteen-foot (4.57m) boiler (*North Carolina Gazette* 1865:1). The engines were thus underpowered, having to push the ship's 781.9 tons in addition to 250 tons of iron plating, twenty tons of coal, the two 7.65 ton Brooke cannon, and a full crew (*North Carolina Gazette* 1865:1).

Neuse was underpowered compared to Porter's pre-war *Seminole* and the bottom-based *Monitor*. The Union ironclad had a 400 horsepower engine and *Seminole* had a 700 horsepower engine (Canney1998:61; Mindell 2000:41). This gives *Monitor* a horsepower to tonnage ratio of 1:2.5, while *Seminole* was 1:1.8. *Neuse* had a horsepower to tonnage ratio of 1:9.8, indicating the engines were asked to work nearly four times harder than those of *Monitor* and 5.4 times harder than those of *Seminole*. *Monitor* and *Seminole* were capable of six and eleven knots respectively, suggesting *Neuse* was far slower than both (Canney 1990:82; 1993:32).

The nine foot (2.74m) propellers were linked and unable to operate independently, creating further inefficiency. Independent propellers allow more maneuverability, important for river vessels. Though this concept became popular during the Civil War, it was too late for *Neuse* (Watts et al. 1990:42). This oversight on *Neuse* was either due to lack of machinery space to accommodate independent shafts or inexperience by the machinists. Therefore, the vessel's speed was likely only a few knots, a common malady for Confederate ironclads (Still 1971:98).

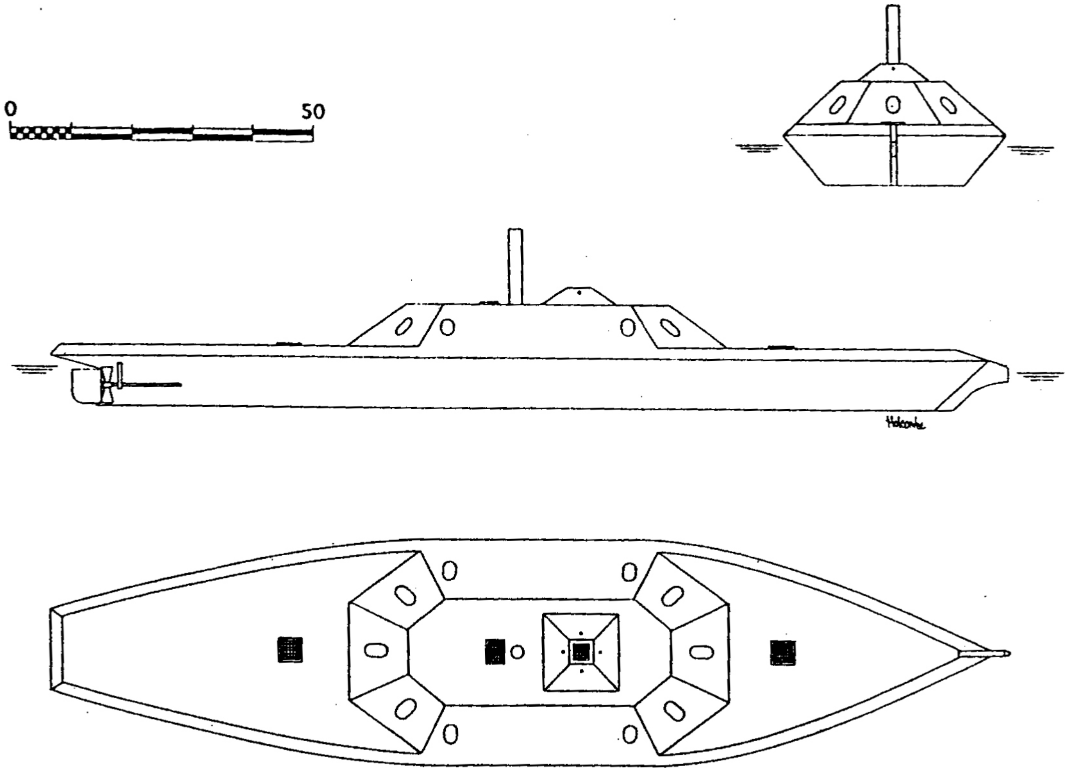

FIGURE III.6. Reconstructed bow, profile, and plan views of *Neuse* (Holcombe 1993.

Naval Architecture

Neuse's block coefficient, calculated from the archaeological remains, is approximately 0.72, indicating it was built full. Similar to cargo ships, the ironclad has increased beam to lighten its draft (Carmichael 1919:41). This broad beam and full build, shown in Figure III.6, would also affect the gunboat's speed (Watts et al. 1990:40). The full form takes a step back toward the Crimean floating batteries, rather than the effective ship-built progression of *Gloire*, *Warrior*, *Virginia*, and *Richmond*. *Neuse*'s design might have been successful fighting as a floating battery in the Neuse River and North Carolina's sounds. Low speed and poor maneuverability, limited by linked propellers, would have made ramming in pitched battle difficult. *Neuse*'s best ramming opportunities would have been against anchored or restricted ships.

Reserve buoyancy is the ratio between areas above and below the waterline, and it is the most important calculation for determining safety in the open ocean (White 1900:8). Porter's planned reserve buoyancy is 27% (Porter 1862b:5); but, in reality, *Neuse*'s reserve buoyancy was between 11% and 16%. Ships with reserve buoyancies this low are generally poor ocean sailors, such as *Monitor*, which foundered off the North Carolina coast with a reserve buoyancy of 10% (White 1900:9). Toward the end of the war, Union monitors were modified by adding eighteen inches (45.7cm) to their decks to raise their reserve buoyancy, thus improving seaworthiness (Canney 1993:80). Thirty percent was the low end of recommended reserve buoyancy for the Royal Navy, with most warship being between 80% and 100% (White 1900:10). *Neuse*'s reserve buoyancy further indicates a harbor or coastal defense ship that would experience difficulty leaving protected waters.

Hull Form

Neuse is distinctly a diamond hull ironclad. With a flat bottom, hard chine, and flared knuckle topped with a casemate, the design is unique to its time and place. *Neuse*'s form belies its function. Its length, draft, and beam, as well as the flat bottom, are marked improvements for shallow vessels over the early ironclads, including the *Richmond*-class. The ironclad shares its flat bottom design with western river steamboats, which discarded the keel, a liability in shallow water, early in the 19th century. *Virginia*'s twenty-three foot (7.01m) draft and *Richmond*'s thirteen-foot (3.96m) draft far exceeded *Neuse*'s eight foot (2.44m) draft (Holcombe 1993:21,65,95). The ship's midsection has a straight run, while the bow and stern have ship curves. Photographs taken during salvage show the stern had a nice run aft, with a lot of tuck for the two propellers.

The hull has an easy curve from bow to amidships with a long run aft to the propellers. The stem is raked, while the sternpost is straight, aiding the large amount of tuck for the twin propellers and rudder. Amidships is boxy, with little curvature for twenty feet (6.1m) before the curves fair to create the bow and stern. This form is more reminiscent of French and English ironclads from the Crimean War than ocean-going ships with a lot of deadrise (Holcombe 1993:4). As discussed previously, *Neuse*'s hull is a slight improvement over a floating battery and the vessel was only an adequate sailor.

Structural Components

Constraints placed on *Neuse*'s shipbuilders show in the wood selection. Longleaf pine composes the majority of the ironclad's timber, while stronger oak was used in small amounts, chiefly in areas potentially vulnerable to gunfire. The casemate's outer layer and the edge of the knuckle at the water line had a layer of oak planking to which the iron plating was fastened. Deadwood constituting part of the ram is also oak (Bright et al. 1981:29).

The main longitudinal components, the keelplank, keelson, and sister keelson, are gum (Bright et al. 1981:29). A choice noted in few other archaeological sites (Snyder 2006:101; Rodger et al. 2009:30), it is, nevertheless, common based on the historical record. Gum trees can grow very large, making them useful for longitudinal timbers. Used throughout the world by shipbuilders, it was common in Virginia, meaning it was likely often used in North Carolina (Brisbin 1888:138). Certainly, the strength of gum was recognized much earlier, as John Lawson mentioned it in 1710 (Lawson 1710:160). All remaining timber throughout the ship is pine.

The bottom is divided by the 138 foot (41.45m) keelplank, measuring 11.8 inches (30cm) sided and 3.9 inches (10cm) moulded. Composed of three timbers, it is joined by simple scarphs. At amidships, there are eight bottom strakes on either side of the keelplank. The average dimensions of the bottom strakes are 14.6 inches (37cm) sided and 3.5 inches (9cm) moulded, wider but thinner than the keelplank. All bottom strakes are joined with simple butt joints.

There are ten strakes amidships fastened to the frames with a series of three treenails and one iron spike. The hood ends are attached using three spikes. The strakes taper in moulded dimension, with the thickest timbers at the chine and the thinnest at the knuckle. Only four strakes run the ship’s full length, the rest being stealers that fill the space between. The strakes were caulked with the only available resources, cotton and tar, which were not completely watertight.

The transition between bottom-strakes and side strakes is bridged by a pinknuckle timber. Showing a face to both sets of strakes, as well as one to frames, it is roughly a hexagon. Floors are attached to keelplank and bottom strakes from below, with the same pattern of one iron spike for every three treenails seen on the strakes. The floors measure 11.2 inches (28.5cm) sided and 9.4 inches (24cm) moulded. The frames are attached to the floors using a simple half-lap joint, common in house carpentry (Bright et al. 1981:7; Richard Steffy quoted in Lang 1980:66). The pinknuckle timber is fastened only with spikes, which alternate between the floors and frames.

The framing system is substantial, if simple. There are 130 frames, measuring 10.8 inches (27.5cm) sided and 9.8 inches (25cm) moulded. Frames sixty-four and sixty-five, the master frames at amidships, were the first two frames erected. These frames are treenailed together, while all subsequent frames are attached with drifts. The first three frames in the bow are cant frames without associated floors. Several frames show breaks associated with using green wood. Top timbers, measuring 10.6 inches (27cm) sided and 10.2 inches (26cm) moulded, are attached to the top of the frames with half-lap joints. The angle of the top timbers and frames create the knuckle.

Frames near amidships on the starboard side show significant repairs. Drifts are driven from an angle rather than the middle of the timber. This is possibly the result of damage caused by Union shelling in December 1862. The ship was resting with its bow downstream, with the starboard side parallel to the river. Further damage is found on the starboard stern, where three bullets remain in the keelson.

Once the bottom and framing were in place, the keelson was laid. Measuring 128 feet (31.01m) long, it is 11.6 inches (29.5cm) sided and 13.6 inches (34.5cm) moulded. The keelson is composed of three timbers joined with simple scarphs. It is attached to the floors and keelplank with drifts driven from above. The bilge keelson measures 24.93 feet (7.6m) long, 11.6 inches (29.5cm) sided and 11.9 inches (30.1cm) moulded. Offset two feet (61cm) starboard from the keelson, it does not extend the vessel's entire length. The bilge keelson's role in *Neuse* is to support the ship's center, where the boiler and engines were installed.

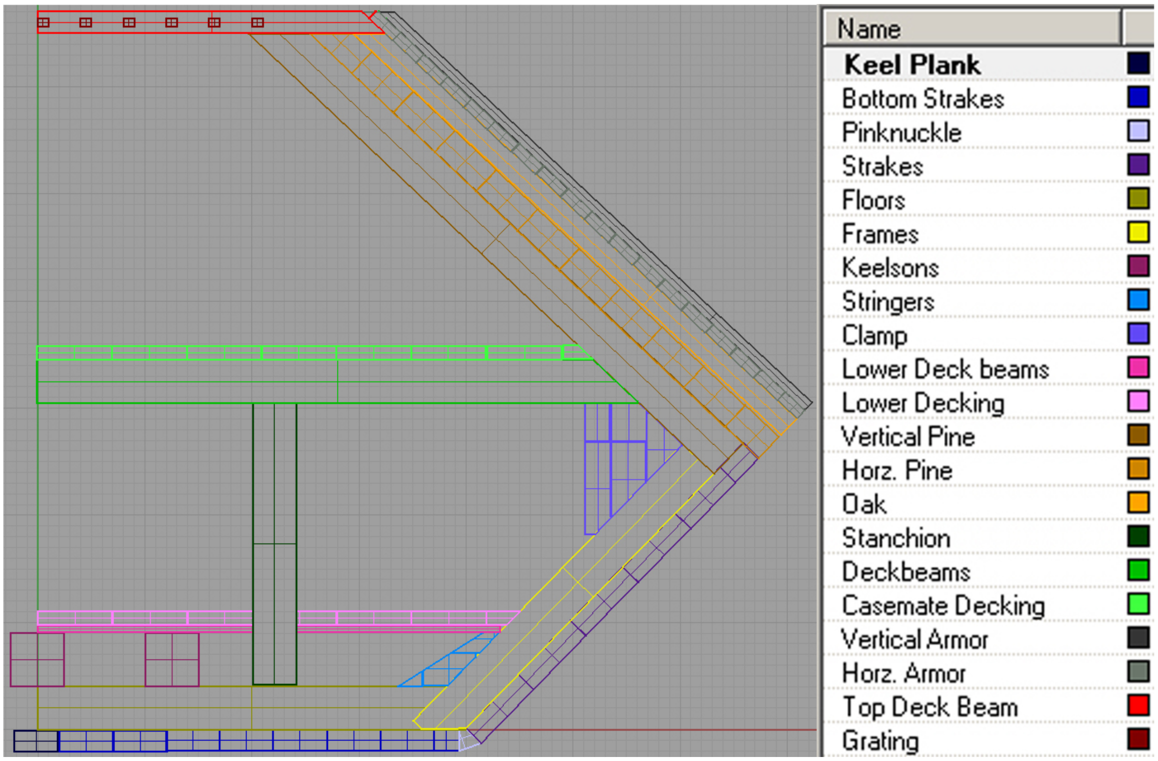

FIGURE III.7. *Neuse*'s midship section, showing construction features (Graphic by author, 2009).

Three bilge stringers run along the interior of the chine, reinforcing the transition between bottom and sides. The main stringer is reminiscent of a cocked hat on western river steamboats, but runs the entire length of the vessel. A four-sided polygon, it measures 10.4 inches (26.5cm) sided by 9.3 inches (23.5cm) moulded and fits snuggly between the floors and the futtocks. The stringer below adds longitudinal strength while acting as a chock, filling the space between the main stringer and the floors, as shown in

Figure III.7. It measures 11.4 inches (29cm) sided and 8.1 inches (20.5cm) moulded. The top stringer is the smallest, measuring 11.4 inches (29cm) sided and 9.3 inches (23.5cm) moulded. It is fitted with notches 3.3 inches (8.5cm) wide and 4.1 inches (10.4cm) deep to accept deck beams for the interior planking. These deck beams ran athwartships across the top of the keelson. Deck planking was then laid fore and aft on top of the beams. Timbers composing the stringers are all joined with butt joints and attached with drifts with washers, the only place on the vessel to use washers.

FIGURE III.8. Internal components being removed during salvage (Courtesy of the William H. Rowland Papers, Joyner Library, East Carolina University, Greenville, NC).

Between the frames and top timbers runs a shelf clamp assembly. Due to the angle of the futtocks and the upper futtocks, it requires five timbers to form the clamp. The interior timber acts as a chock, filling the empty triangular space, allowing for the rectangular clamp to be fitted to it. It is triangular, with the interior face measuring twelve inches (30.5cm). Two timbers create a layer on top of it. These measure twelve inches (30.5cm) sided and 11.4 inches (29cm) moulded. Two additional timbers are placed on top of these, measuring twelve inches (30.5cm) sided and 3.5 inches (9cm) moulded.

The deck beams fit between the top timber and the clamp. The deck beams were removed during the 1960s salvage, but photographs show dimensions similar to frames, approximately eleven inches (28cm) sided and 9.8 inches (25cm) moulded. Running longitudinally on top of the deck beams were deck planks, estimated as two inches (5.1cm) thick from the salvage photographs.

Though none of the casemate survives intact today and very little was found in the 1960s, it is nevertheless possible to reconstruct its structure. The casemate rested on the deck beams and bulkheads at amidships. The body was composed of three layers of pine, a layer of oak, and two layers of iron armor plate. It was fitted with ten gun ports, allowing each gun to fire directly ahead, from two quarter-panels, or broadside from both port and starboard. The gun port shutters were designed to pull shut from the recoil force (White 1864:5). The top of the casemate was composed of two-inch (5.1cm) planking supported by light beams that also supported the pilothouse (Bright et al. 1981:14).

The bow assembly is noteworthy. There is no true stem, instead a compass timber forms the beginning of a stem, though it is only 42.9 inches (1.09m) in height. The rest of the stem is composed of two pieces of deadwood resting on the keelson; drift holes indicate at least one additional piece. The keelplank, keelson, and deadwood are rabbeted to accept the strakes, showing that the deadwood is an integral part of the stem assembly. The rabbet is approximately one foot (30.5cm) aft on the deadwood, indicating a significant portion of the deadwood was outside the vessel. The hood ends of the strakes suggest that there were at least five pieces of deadwood. The strakes were held to the rabbet with two iron spikes each.

Internal components were either thrown in the river or burned during the 1960s salvage (Rowland 2008, pers. comm.). An 8mm film and photographs indicate the general layout of bulkheads. The bulkheads show no evidence of the diagonal bracing used for added strength in western river steamboats (White 1900:377). Large stanchions, approximately one foot (30.5cm) square, supported the casemate, as shown in Figure III.8. Otherwise, the general plan follows the traditional United States Navy layout, down to the location of scuttles and a light window for the powder room (Bureau of Ordnance 1866:40).

Construction

Construction on *Neuse* began by building stocks in Whitehall. A North Carolina soldier’s account describes the ship on rollers (Bright et al. 1981:6). This was necessary to access the bottom, as well as for launching the vessel. A large panel of strakes was laid on top of the stocks, with the gum keelplank in the center. The patterning of the butt joints suggests the first strakes were laid beginning where the bow would be. The ship’s shape was then cut from the panel while temporary fastenings held the strakes in place. There is no evidence of temporary fasteners on the underside of the vessel, indicating either that the fasteners were on the top or more substantial fastenings were driven through the temporary fasteners later. With the bottom of the vessel laid out, a map for the rest of the timbers was created.

The master frames' floors were then laid at amidships and fastened from below. The frames were then added. The subsequent floor and frame sets were built outwards from the master frames, indicated by all drifts in the ship pointing toward the master frames. Once framing was complete, the keelson was laid and fastened through the floors and keelplank with drifts driven from above. With the keelson in place, support was available for adding the stem assembly and sternpost.

Stringers were then added to strengthen the chine, beginning with the center stringer. These were fastened from above by iron fasteners and below by treenails. The strakes were then added, beginning at amidships. The decking and the sides of the casemate were constructed, allowing room for the engines, boiler, and cannon to be loaded later. At this point in construction, the ship was turned over to the navy and taken to Kinston. The internal bulkheads and fittings were added at the naval station, along with the machinery.

CHAPTER 4: *JACKSON*

The keel for *Jackson* was laid in either late December 1862 or early January 1863 at Columbus, Georgia. By 18 June 1863, the center paddlewheel ironclad was complete enough to begin caulking, laying the deck, and installing engines. The ship was essentially finished by late December, lacking only its cannon and stores (Mueller 1990:112). *Chattahoochee* was refitted, and torpedo boat *Viper* was built, in this yard (Turner 1988:177).

The navy yard and ironworks were administered by Lieutenant Augustus McLaughlin, who was aided by Chief Engineer James Warner. Charles Blain, a civilian shipwright who built river steamboats before the war, ran the yard. In 1860, Blain supervised construction of two ships in the renowned Pennsylvania steamboat yards, and it appears he made numerous trips to these yards through the years (Mueller 1990:102). Following the successful launch of *Jackson*, the local newspaper said of Blain, "one of the most superb of boat builders, was master mechanic, and he has done this work perfectly… Capt. Blain personally superintended the successful launch. He never yet at Columbus has failed one" (Mueller 1990:116). The complex joinery within the vessel also shows the skill of the shipbuilders.

The shipyard attempted to launch *Jackson* around New Years 1864, but the ironclad would not lift off the ways, despite using towboats (Turner 1999:170; Mueller 1990:112). The ship's casemate was too heavy and the draft too deep, the ever present malady of Confederate ironclads. These problems required modifications, prompting a visit from the Chief Naval Constructor.

Porter arrived in Columbus on 23 January 1864, and inspected the ironclad, determining its draft was a major problem (Turner 1999:172). In February, Porter returned to Columbus, having decided to rebuild the ironclad. He shortened the casemate by fifty-four feet (16.46 m) and extended the stern twenty-seven feet (8.23 m) to accommodate twin propellers. The central paddlewheel was removed and the wheel well was planked over. These changes took months, but by the end of May, the new stern was being planked. The ship was finally launched on 22 December 1864, experiencing none of the difficulties of the previous year (Mueller 1990:112-116). Shortly thereafter, the only known photograph of the ironclad was taken, seen in Figure IV.1.

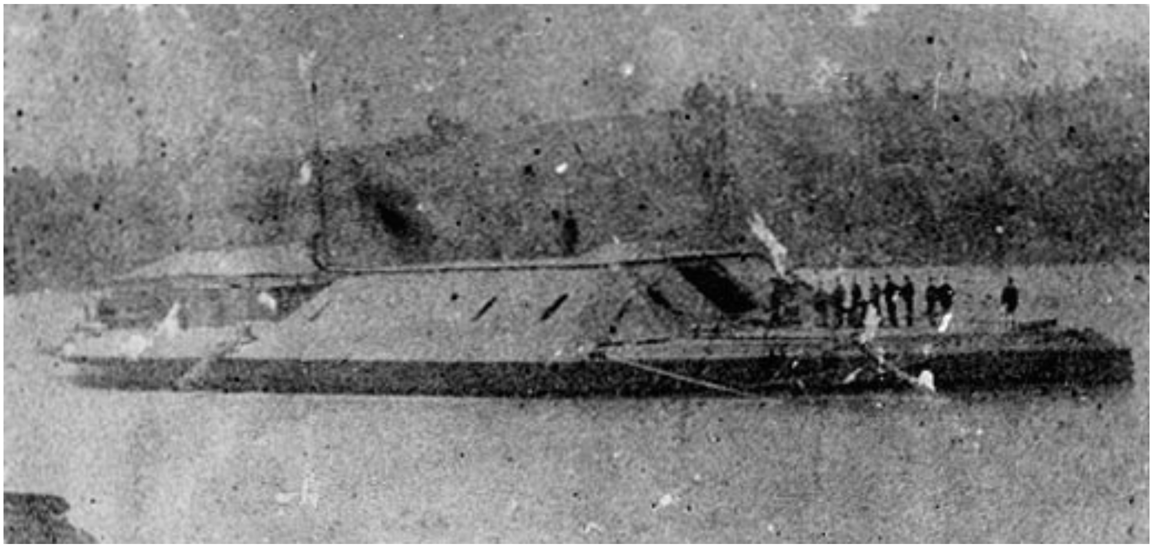

FIGURE IV.1. *Jackson* in 1864, with an opening in the bow for loading supplies and a canopy in the stern to protect workers from the sun (Naval Historical Center 1864: NH48026).

Jackson's conversion from paddle wheel to propellers was necessary, but Porter received harsh criticism. By 1864, the navy realized paddle wheels functioned poorly on ironclads, due to variable immersion and poor flow over the rudder. *Louisiana*'s central paddlewheels did not function (Holcombe 1993:49). *Missouri*'s sea trials on 17 June 1863 showed the design to be exceedingly slow (Jeter 1987:275). *Missouri*'s wheel well was extended to increase the amount of water reaching the paddle wheel, but performance improved only minimally. The paddlewheel could not stem the Red River's current, trapping *Missouri* at Shreveport for the war's duration.

The availability of river steamboat engines and boilers was the determining factor in the decision to equip the *Missouri*-class with a center paddlewheel. As a result, *Missouri* and *Jackson* were the only two diamond hull ironclads designed without propellers (Holcombe 1993:92). The debate between paddlewheels and propellers was ongoing during the war (Diveley 2008:385). Developed in the 1830s, propellers did not become standard until iron construction was commonplace, due to vibrations from the shafts opening seams in wooden ships (Gould 2000:270). The Royal Navy began using propellers in 1843 with the success of HMS *Rattler* (Brown 1990:112). At the outbreak of the war, the Union navy consisted of nineteen propeller driven ships out of fifty-two, twenty-two of which were sail (Canney 1998:17). In 1865, thirty-seven screw, twenty-four paddlewheel, and fourteen sail composed the West Gulf Blockading Squadron (*Official Records of the Navies* 1[22]:12). Forty-seven paddlewheel warships were built by the navy, including thirty-nine double enders for river use, while fifty-four second-hand paddlewheel ships were purchased (Canney 1998:69,74-75).

Both Union and Confederate navies attempted paddlewheel warships due to availability, though an exposed wheel proved flawed. In addition, paddlewheels and their machinery took up more space (Morrish 1872:73). By removing the paddlewheel machinery, Porter was able to shorten the casemate. Therefore, *Jackson* had to be heavily modified to accommodate propellers.

An entirely new stern was necessary because the bluff paddlewheel stern did not provide the long run and tapered end required for propellers (Carmichael 1919:39). Lengthening a vessel to install propellers was not uncommon in either the American or British navies (Morrish 1872:73). HMS *Duke of Wellington*, for example, had its stern rebuilt and lengthened thirty feet (9.14m), on paper becoming the largest and most powerful steam warship at its launch in 1852 (Chambers and Chambers 1854:218; Singer and Raper 1978:587). In reality, *Duke of Wellington* suffered structural weakness due to its modifications, despite being the first steam powered ship of the line. *Duke of Wellington* became a flagship in the homeport of Portsmouth to avoid exposing its limitations.

The Confederacy used an experienced naval engineer, William P. Williamson, for *Jackson*'s modifications. Williamson had directed conversion of *Alleghany* from Hunter wheels to propellers in 1852, including extending and rebuilding the stern down to the sternpost (Bennett 1896:55-56). As with *Duke of Wellington* and *Alleghany*, *Jackson*'s stern was sawn off, and a completely new stern was built with a lengthened run and more tuck. *Jackson*'s new twenty-seven foot (8.23m) stern was V-shaped in the extreme aft, allowing water to flow past the two propellers and rudder. Once re-launched, installation began on *Jackson*'s armor and the interior layout was altered. Coalbunkers, magazine, and a shell room were shifted to the stern to distribute weight and keep the ironclad's draft under six feet (1.83m) (Mueller 1990:116).

Unfortunately for the Confederacy, the war was drawing to a close. On 17 April 1865, Federal cavalry under General James H. Wilson captured Columbus. Unable to hold the town, the cavalry destroyed much of it, including pouring accelerant into *Jackson*, shown in Figure IV.2, setting it on fire and adrift. Before firing the ironclad, General E. F. Winslow wrote an account of the ship. Several of Winslow's details do not match the physical record, but it is one of the few contemporary descriptions. He noted that the vessel was probably two weeks from being completed (Mueller 1990:117). The burning hulk floated thirty-two miles downstream before coming to rest on a sandbar. Local lore claims that it burned for two weeks (Jeff Seymour 2008, pers. comm.).

FIGURE IV.2. Location of *Jackson*, labeled as 1, during Wilson's capture of Columbus (Watts et al. 1990:21-22).

Immediately following the war, a contract was signed by the Treasury Department to recover "naval machinery, stores, saltpetre," on *Jackson* and the wooden gunboat *Chattahoochee* (National Archives 56[175]:275). The scuttled ironclad created a navigation hazard, so in 1910, the Amy Corps of Engineers dredged around the ship and removed the boilers, engines, and several cannon (Turner 1961:17).

Interest during the Civil War centennial caused widespread relic hunting throughout the South. Reading accounts of the amateur excavation of *Neuse*, a local group under Joe Willman, Jr. located *Jackson*. The ironclad was salvaged in a manner similar to *Neuse*, as shown in Figure IV.3. During exhumation, the vessel's structure suffered immense damage and the site was destroyed with no archaeologists present. Moving the vessel proved difficult, so the salvagers used dynamite to split the vessel in two. The salvers kept many associated artifacts, while others were improperly stored and are no longer available.

FIGURE IV.3. *Jackson* during an early stage of the salvage operation (Courtesy of Port Columbus National Civil War Naval Museum, Columbus, GA).

The intact fantail, complete with iron plating, was found in the riverbank. It is the only surviving portion above the waterline, due to its supporting structure burning through, causing the fantail to fall into the river. The bow fragment is in poor condition, though enough remains for a reconstruction. The stern fragment is in excellent condition, including the planked over wheel well and the propeller stern.

Dimensions

The *Missouri*-class construction plans indicate a length of 190 feet (57.91m), an extreme beam of fifty-six feet (17.07m) and a draft of six feet (1.83m) (Porter 1862b:1). Holcombe notes the plans show an overall length of 193 feet (58.83m) and depth of hold of nine feet, nine inches (3m) (Holcombe 1993:106). A compliment of eight cannon armed the ironclad. *Jackson*'s dimensions changed due to Porter's modifications, leading Holcombe to award the Columbus ironclad "the dubious distinction of being the most altered ironclad built in the Confederacy" (Holcombe 1993:109). It is fortunate that *Jackson* survives in the archaeological record, since the alterations illustrate changing views within the Confederate navy.

Contemporary accounts vary from highly speculative to potentially accurate. A deserter gave pre-conversion dimensions of 120 feet (36.58m) in length and a depth of hold between ten and twelve feet (3.05 to 3.66m) (Mueller 1990:111). While certain changes are to be expected, this number differs greatly from Porter's plan, suggesting that one or the other source is not well founded.

General E. F. Winslow's post-conversion dimensions are 250 feet (76.2m) in length, with a forty-five foot (13.72m) beam, and a 6.5 to 7.5 foot (1.98 to 2.29m) draft (Mueller 1990:117). He described the casemate as forty feet (12.19m) long and twenty feet (6.1m) wide. The height was nine feet (2.74m). These measurements generally correspond with *Jackson*'s photograph. Winslow stated the ram was fifteen feet (4.57m) long. Winslow misjudged several details, such as the wood type and the beam. He nevertheless remains the best source for internal components, none of which survived salvage.

The extant structure is in three sections, bow, midship to stern, and the fantail, as shown in Figure IV.4. The bow section is 73.6 feet (22.44m) long and is the most heavily damaged. The midship to stern section is 103.7 feet (31.6m) long, with a height of 7.3 feet (2.23m). The breadth measurement across the bottom is 35.43 feet (10.8m). It includes the twenty-seven foot (8.23m) rebuilt propeller stern. The fantail is complete, with its support structure charred but largely intact. Connecting the curvature of the two segments, a combined 53.3 feet (16.2m) is missing from the bow and dynamited midsection. Reconstructed, the ironclad's overall length, including the fantail, is 240.64 feet (73.3m).

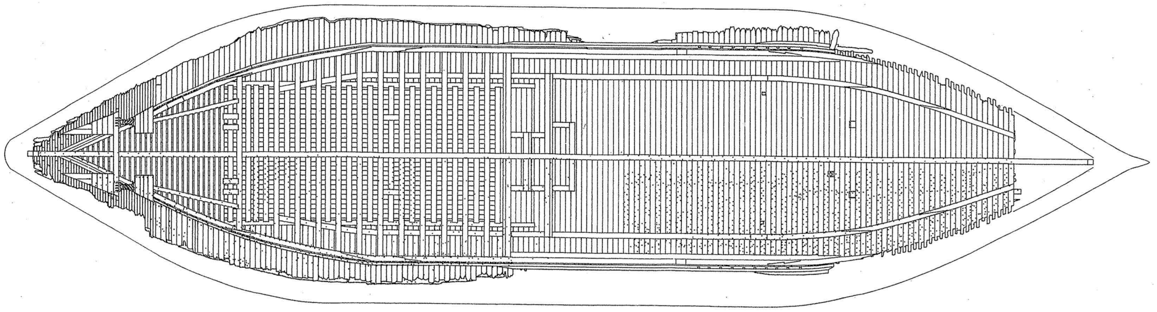

FIGURE IV.4. Plan view of *Jackson* with the dynamited midsection reconstructed (Prados and Mannesto 1993:1).

Jackson's reconstructed displacement is approximately 2,201 short tons. This figure more than doubles *Neuse*'s displacement, primarily due to its increased beam and straight run along the majority of its length. The general dimensions give a gross tonnage of 638 and a net tonnage of 515. A crew list does not survive, but *Jackson* likely had a larger crew than the *Neuse*'s ninety-four, since it had four boilers instead of one.

Estimating a crew of 120 for additional boiler teams, *Jackson* had a tons-per-man ratio of 18.3:1.

Jackson's machinery is missing, but the propellers and their shafts remain. Winslow stated that *Jackson*'s two engines had a thirty-six inch (91.4cm) stroke and bore, supplied by four boilers (Mueller 1990:117). Each engine powered an independent seven and a half foot (2.29m) diameter propeller. The propeller shafts are six inches (14.5cm) in diameter, while the mounts are 47.2 inches (120cm) long and twenty-four inches (60cm) sided.

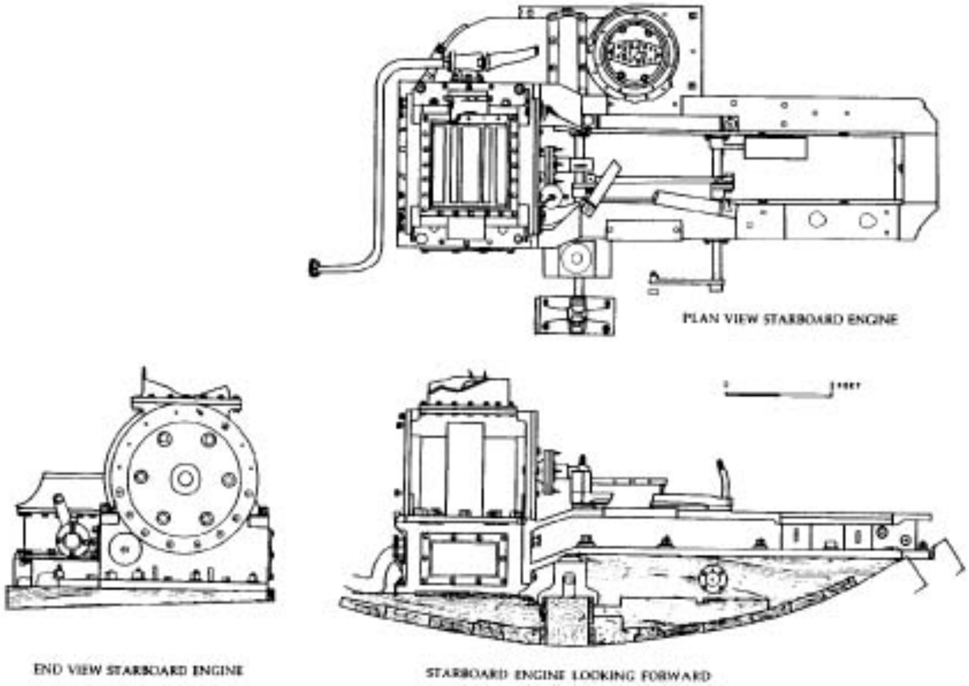

FIGURE IV.5. *Chattahoochee*'s engines, likely similar to *Jackson*'s engines (Watts et al. 1990:44).

Like its construction, *Jackson*'s machinery combined new and old ideas (Watts et al. 1990:42). The Columbus navy yard built a number of engines for wooden gunboats and ironclads, including those in *Jackson* and *Chattahoochee*. *Jackson*'s 36-inch bore and stroke engines were a larger version of *Chattahoochee*'s twenty-eight inch (71.1cm) diameter and twenty inch (50.8cm) horizontal direct acting inline two cylinder two crank single expansion engines, seen in Figure IV.5. These were low-pressure, condensing, reciprocating engines (Watts et al. 1990:42).

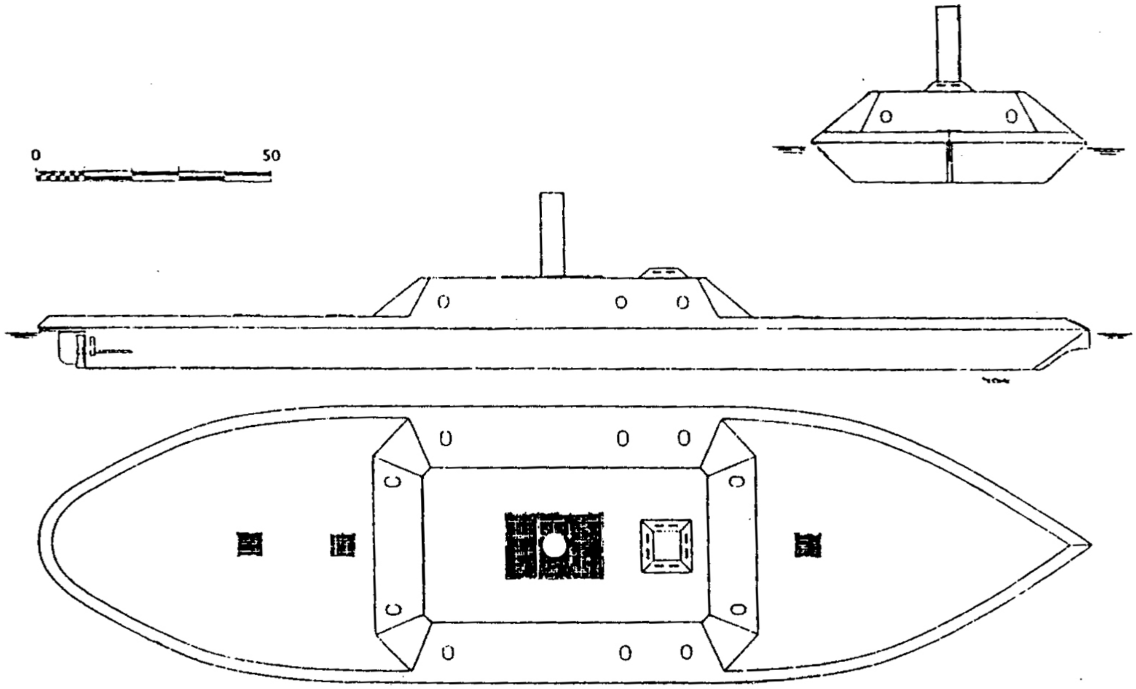

FIGURE IV.6. Reconstructed bow, profile, and plan views of *Jackson* (Holcombe 1993).

Naval Architecture

The original paddlewheel design gave *Jackson* a straight run and bluff stern that are a poor choice for a naval vessel due to the resistance and eddies they create (Attwood 1902:245). Porter attempted to mitigate this with the rebuilt stern, but the vessel kept its boxy paddlewheel shape. *Jackson*'s block coefficient of 0.76 is therefore greater than the other, propeller designed, diamond-type ironclads, except *Missouri*. This block coefficient correlates to cargo ships, rather than warships (Carmichael 1919:41). *Jackson* likely handled like a cargo ship, in essence a floating battery, and would have found it difficult to ram another ship in an open water pitched battle. Had the Union navy advanced up the Chattahoochee River, *Jackson*'s ram could have hit targets in the restrictive waters, and its two forward guns would have been formidable.

Jackson's reserve buoyancy is designed to be a third of its displacement (Porter 1862a); but in reality, it was approximately 16% (Mueller 1990:117). Similar to *Neuse*, this reserve buoyancy percentage indicates *Jackson*'s operating conditions were limited to sheltered waters. This figure is unsurprising, since the diamond-type ironclads were designed for harbor defense. *Jackson* still might have experienced trouble, such as swamping or foundering in the relatively open waters of Apalachicola Bay, had it been completed.

Hull Form

Jackson's hull form features the flat bottom, hard chine, and flaring knuckle of diamond hull ironclads. The main difference between *Jackson* and the other diamond hull ironclads is the much wider beam to accommodate the wheel well. The paddlewheel design gave the vessel a straight run and rounded stern, problematic since it made eddies, causing variable immersion (Attwood 1902:245). With the propellers installed, a curved run with a lot of tuck was created by the twenty-seven foot (8.23m) addition. An iron-plated fantail protected the rudder, differing from the easier to build transom stern found on other diamond hull ironclads (Holcombe 1993:97,101,104). Fantails were developed on New York clipper ships in the mid-1840s and became popular in the North by the 1850s (Chapelle 1976:40). *Arkansas* is the only early ironclad with a fantail, while *Milledgeville* and *Wilmington,* the last two gunboats laid down, are the only late war ironclads (Holcombe 1993:41,124,129). Together with *Jackson*'s 1864 propeller stern, this evidence suggests a shift toward the popular, but more complex, fantail on late war ironclads. This change might have been motivated by the experienced officers on Mallory's 1864 ironclad committee.

The *Missouri*-class resembles the 1861 Union city-class ironclads built on the Mississippi River. Porter was cognizant of the Union river ironclads, though it is doubtful he copied them. Their designer, Samuel Pook, was one of Porter's former instructors (Park 2007:17), so it is likely any similarities are due to shared theory rather than direct imitation. These river ironclads were "as much products of the industrial process and place as the historic persons who conceived them" (Garrison 1995:27). The use of river steamboat engines and a casemate to protect the paddlewheel is not an innovative concept. Porter's design has more similarities to other diamond type ironclads than to the city-class ironclads, despite the use of the center paddlewheel.

Jackson's rebuilt stern is comparable to the other diamond hull ironclads with propeller sterns, such as *Albemarle* and *Neuse*, with the exception of the fantail. Porter's conversion order followed *Missouri*'s trials as well as *Neuse* and *Albemarle*'s fitting out (Bright et al 1981:10, Jeter 1987:275). In fact, the remains of *Neuse*'s stern bears a striking resemblance to *Jackson*'s stern. Porter and other naval officers visited both North Carolina ironclads and *Jackson* to aid construction (Bright et al. 1981:10; Turner 1999:172; Still 2008:33), suggesting that the successful stern configuration of the *Albemarle*-class was transferred to *Jackson*. Further evidence comes from a pinknuckle timber on the propeller stern, a timber not found in the older section.

Structural Components

The pine keelplank runs the length of the vessel, though before the conversion to propellers it ended at the wheel well. It measures 12.8 inches (32.5cm) sided and 4.5 inches (11.5cm) moulded, and the timbers are connected with horizontal scarphs and athwartships iron fasteners. The bottom-strakes, in contrast, are only four inches (10cm) moulded, while being ten inches (25cm) sided.

The strakes run straight with little curvature, using few stealers. The average strake measures 10.6 inches (27cm) sided and 4.3 inches (11cm) moulded. Running along the eighth strake for the length of the vessel is a timber used to support iron plate, reminiscent of a rub rail. It is 5.2 inches (13.3cm) sided and 1.8 inches (4.5cm) moulded, with the top face notched 0.9 inches (2.2cm) to accept the iron plate.

The 1863 portion of *Jackson* does not use a pinknuckle timber. Instead, the bottom-strakes and side strakes are cut and tapered to receive each other. The propeller stern introduced a pinknuckle for twenty-seven feet (8.23m). Rather than a small transition, as on *Neuse*, *Jackson*'s pinknuckle is a plank forming an attachment for the strakes while being abutted to the bottom-strakes.

The floors measure twelve inches (30cm) sided and 12.6 inches (32cm) moulded and are joggled to meet the keelplank. Additionally, two limber holes are cut on either side of the keelplank, measuring 2.5 inches (6.4cm) sided and 0.9 inches (2.2cm) moulded. The frames are attached to the floors using a half-lap scarph, the same joinery as *Neuse*'s floors and frames. In the former wheel well, the floors are spaced a foot (30.5cm) apart and have riders for additional strength. Interestingly, as the bow's curvature enters the side's straight run, the frames increase in sided dimensions, from 10.9 inches (27.8cm) to 11.7 inches (29.6cm), while the moulded dimension decrease, from 11.2 inches (28.5cm) to ten inches (25.5cm). The master frames are located in this transition area, indicated by drifts forward of this frame set being driven aft, and those aft are driven forward. Figure IV.7 shows the drifts in the starboard stern pointing forward, in the same method as the Pasquotank barge in Figure II.13. To create the ship's curve and tuck in the stern, the frame dimension changes to 5.9 inches (15cm) sided and 9.8 (25cm) moulded. The tops of the frames are burned, but the similarity between the floors and remaining frame portions suggest the use of top timbers with half-lap scarphs as found on *Neuse*.

FIGURE IV.7. *Jackson*'s drift fastening pattern (Photograph by author, 2009).

The keelson rests on the floors, fastened from above. It measures 11.4 inches (29cm) square, while the rider keelson is eleven inches (28cm) sided by 10.4 inches (26.5cm) moulded. The timbers composing the keelson and rider are connected using hook scarphs. Longitudinal support is added by two bilge keelsons. Measuring 9.6 inches (24.5cm) sided and ten inches (25.5cm) moulded, the bilge keelsons use a complex horizontal hook scarph on the aft of each timber with a vertical hook scarph forward, locking each component in place.

The stringer assembly runs the length of the vessel on the interior of the chine, as shown in Figure IV.8. Composed of six stringers, the lowest measures 9.4 inches (23.4cm) sided and 4.6 inches (11.7cm) moulded. The second stringer is the largest, measuring 9.6 inches (24.5cm) sided and 13.6 inches (34.5cm) moulded. The timbers composing the two bottom stringers are joined using hook scarphs, while the upper stringers use butt joints. The third stringer is 5.3 inches (13.5cm) sided by 3.9 inches (10cm) moulded. The fourth is 7.7 inches (19.5cm) sided and 3.9 inches (10cm) moulded. This stringer is fitted with notches to receive the ends of the interior deck beams. The beams lay across the top of the rider keelson with planks laid longitudinally on top. The fifth stringer is 6.3 inches (16cm) sided and two inches (5cm) moulded. The sixth stringer survives in only a few areas. It is reminiscent of ceiling, measuring only six inches (15cm) sided by two inches (5cm) moulded. No fasteners are located above this stringer, so no further ceiling was laid, suggesting it is part of the stringer assembly.

The chine assembly changes upon reaching the former wheel well. Only three stringers are used, a continuation of the second, third, and fourth stringers. The joinery on the stringers near the wheel well is complex and illustrates the skill of the shipbuilders.

The fire consumed the entire upper structure. The bow is also missing, likely due to dredging or river erosion. Based on construction plans, historical accounts, and photographs, these areas are similar to *Neuse*'s upper structure and bow. No evidence of a clamp to support the decking survives. A clamp must have been used, since there is no evidence of knees. The clamp assembly probably would have mirrored the stringers, as on *Neuse*. While decking and casemate are also missing, the *Jackson* photograph shows similar construction to *Neuse* and other ironclads. Fire damage is beneficial for determining hatch locations, as one was located forward and two aft.

The stern has excellent preservation. Deadwood is stacked on the rider keelson to build up the stern. The deadwood measures twelve inches (30cm) square and eleven feet (3.37m) in length, supporting a knee attached to the sternpost. The knee is 7.9 inches (20cm) thick with the forward leg measuring fifty-two inches (1.32m) and the vertical leg measuring twenty-six inches (66cm). It is connected with drifts to the sternpost, measuring 12.8 inches (32.5cm) sided and 10.2 inches (26cm) moulded. The rudderpost, in turn, is attached to the sternpost by drifts running forward and measures 12.8 inches (32.5cm) sided and 11.2 inches (28.5cm) moulded. The strakes are angled for capturing the curvature.

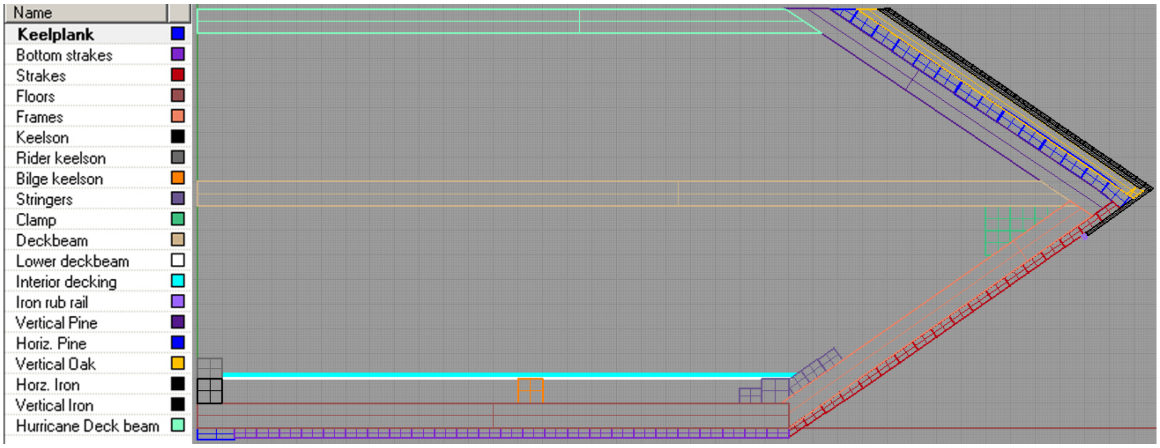

FIGURE IV.8. Cross section of *Jackson*, forward of the former wheel well, showing construction features (Graphic by author, 2009).

The fantail was anchored to the vessel with three timbers measuring approximately one foot (30cm) sided by ten inches (26cm) moulded. Three transverse timbers measuring 8.3 inches (21cm) by 11.4 inches (29cm) are fitted to the underside of these heavy timbers, followed by a semicircle composed of fourteen pie-shaped pieces.

The semicircle creates the rudder's arc along the bottom face of the fantail. The rudder is held in place by a guide timber, composed of five pieces, running around the outside of this face. These timbers are twelve inches (32cm) sided and four inches (10cm) moulded. They are aided by two chocks on the forward face of the bottom face, preventing the rudder from turning beyond ninety degrees.

The fantail's upper face has two layers of pine, the inner measures ten inches (25cm) sided and three inches (7cm) moulded, while the outer is ten inches (25cm) sided and five inches (13cm) moulded. Two inch (5.1cm) iron armor plating is fitted on top of this, curved around the waterline for protection. The iron plate is flush with the wooden decking.

Construction

Construction began by digging a slough near the ironworks. Still visible today, the slough includes pilings for launching at thirty degrees downstream. The ironclad was built on stocks within the slough, likely spaced two feet (60.9cm) apart. This spacing is based on the bottom-strakes having rows of treenails every two feet (60.9cm), with spikes in between. The keelplank and bottom-strakes were laid first as a large panel. Half-inch (1.3cm) dowels temporarily fastened these timbers in place, possible with the use of cleats.

The shape of the bow and stern were cut out of the bottom panel. The wheel well was then cut and two one-foot (30.5cm) square timbers were placed along its edges for support. Once the bottom was in place, the first two floors were laid approximately thirty feet (9.14m) from the bow. The master frames could not be located amidships, as is convention, due to the wheel well. After creating the master frames, all subsequent floors and frames were added outwards from there. All floors are fastened from below.

The frames and top timbers were attached in sets at the same time as the floors. The frames have alternating half-lap joints on either end, fitting into the floors at the bottom and the top timbers above. Three drifts connect each frame to the preceding one and one drift connects the top timbers.

With the floors, frames, and top timbers in place, the keelson was fastened through the floors and keelplank using drifts from above. The rider keelson then followed. With the keelson and rider keelson in place, the stem and sternpost could be added. Fastened directly into the keelplank, the sternpost and rudderpost are also fastened to each other. A piece of deadwood was fastened to the rider keelson and sternpost, as well as a stern knee atop the deadwood. In the bow, no timber survives, but it is likely a slightly raked stem was attached to the keelplank and three to four pieces of deadwood in the same manner.

The chine assembly was then added to support the frames. The strongest timber in the assembly, stringer two, was laid first. It is fastened with spikes alternating between floors and frames. Stringer one was added next, attached only to the floors. The remaining stringers followed. The deck clamp assembly was likely comprised of two to four layers. The deck beams fitted between the space created by the frames and futtocks, resting on top of the clamp.

With primary structural supports in place, strakes were added to the exterior. When the new stern was created, several strakes were removed to decrease the number of butt joints in the attachment area. Nevertheless, it remains evident where the new section begins.

The casemate was built on top the decking with no structural components extending below deck. In the forward and aft casemate sections, vertical timbers angled at 35 degrees were fastened to the deck with drifts. In the midsection, the timbers attached to the half-lap joints on the frames. The casemate's top and forward section were left open to load the engines, boilers, and ordnance. Once launched, internal components were finished, including bulkheads, and the interior was painted (Turner1988:168).

CHAPTER 5: FINDINGS AND ANALYSIS

"God said, 'Let there be light,' and there was light" (*Holy Bible* 1885:2). Fortunately, ships are built from traditions that can be traced. The archaeological remains of *Neuse* and *Jackson* show these vessels were not built in a vacuum, but rather used traditions established well before 1861, while incorporating significant new traits developed by martial selection during the early phase of the Civil War. Using comparative vessels known to use vernacular construction and bottom-based construction, as well as identified western river steamboats, key traits are observable allowing for thick description. Novel design, and its survival through martial selection, is evident by comparing remains of *Neuse* and *Jackson*, as well as contrasting each to other Confederate ironclads.

Comparison Between *Neuse* and *Jackson*

Neuse and *Jackson* are the same typology and basic construction, but the ships are visibly designed and built separately. In gross anatomy, *Jackson* dwarfs *Neuse* due to its beam to accommodate the paddlewheel, as well as the extension for propellers. The Columbus ironclad is heavier built, beyond its larger size, utilizing a heavier chine assembly and a rider keelson. The workmanship on *Jackson,* as evident in the joinery, is also superior to that on the North Carolina ironclad. *Neuse* is superior in propulsion, though underpowered compared to Union ships, with its engines, boiler, and propellers of apparent high quality, while *Jackson* underwent a number of changes to correct its poor center paddlewheel design, problems with weight distribution, and second hand boilers.

Both ironclads show signs of pre-war utility boat, merchant ship, and riverboat traditions, unsurprising since many shipbuilders built such vessels before the war, such as the builders of *Albemarle*, who constructed flatboats (Maffitt 1880:501). In fact, Elliot continued building flatboats at Edward's Ferry during the war for foraging (Hinds 2001:46). Though the war imposed rapid changes in form, the structural systems used in the ironclads show indications of the pre-war traditions of their shipbuilders. Comparison of the assembly order, structural systems, materials, and structural components identifies variations between the ships, while also identifying commonalities due to design or popular culture.

Assembly Order

The assembly order for both ironclads is analogous. The construction on stocks is evident in the fastening pattern on the vessels' bottoms, as well as the historical record and the slough dug in Columbus. A panel was created with the bottom-strakes and keelplank, and then the vessel's shape was cut out. *Jackson* utilized dowels for temporarily fastening the bottom together, but there no physical evidence remains of a temporary fastening system on *Neuse*. The floors and frames were laid, beginning with the master frames, and then built forward and aft simultaneously. Once the bottom was constructed, the chine assembly was placed. Finally, the keelson, rider keelson, and bilge keelsons were added, fastened from above. The posts were placed, fastened directly into the keelplank, followed by deadwood. The decking and casemate structure were built on top of the frames and top timbers, with an opening for engines and boilers to be lowered into the hull. This method of assembly differs conceptually from frame-first shipbuilding, as the cut panel guides construction.

Structural Systems

Neuse and *Jackson*'s structural systems differ in practice but are similar in theory. The lack of a true keel is compensated for by strength of the bottom, composed of a keelplank, bottom-strakes, and heavy floors. It is augmented by a keelson and stealer bilge keelson in *Neuse* and a keelson, rider keelson, and two bilge keelsons in the larger *Jackson*. The chine assembly provides longitudinal strength, while also buttressing the transition between the floors and frames. Similar to the keelson, *Jackson*'s chine assembly is heavier built than *Neuse*'s assembly. The timbers used for the keelplank, bottom-strakes, and keelsons are the largest on each vessel.

Materials

The materials are similar in both ships. The primary timber used is longleaf pine, the mainstay of Southern vessels, together with cypress. Shipwrights adopted pine and cypress during the early colonial period. By the mid-19th century, oak was becoming scarce throughout the United States and pine replaced it. Northern shipbuilders began lumber mills in the South, with some even moving their shipyards, in order to supply them with enough pine (Fleetwood 1995:143).

The ironclads were not supplied with seasoned pine. Navy officials working on them complained of green wood use. Benjamin Loyall described *Neuse,* saying "…when a boat, built of green pine & covered with four inches of iron, gets under fire of heavy ordnance, she will prove anything but bomb proof- This vessel is not fastened &

strengthened more than a 200 ton schooner" (Bright et al. 1981:14). Loyall's fear of green timber was well founded.

Wood shrinks once cut and can become warped or fracture (Watts 1999:14). When wood used in ships without proper drying has these same issues, seams open in the ship. Use of green wood was a major cause of *North Carolina* sinking at its moorings (Peebles 1996:55). Longleaf pine (*Pinus palustris*) is the primary wood in most Confederate ironclads, due to its abundance in southern forests, its effectiveness for shipbuilding before the war, and the scarcity of oak. Longleaf pine weighs 56 pounds per cubic foot when green, but this number drops to 42-45 when dried (Desmond 1984:17). A one-foot square timber, common on both vessels, shrinks by 1.25% when dried. By weight, conservatively 19.6% is lost and as much as 25% can be lost. Combined with poor cotton caulking, the seams of the ironclads leaked badly. When under enemy fire, green wood is more likely to fracture than seasoned wood. Floors and frames on both ironclads show evidence of green wood fractures, while *Neuse* also shows a repair for shrinkage on a port stern frame.

Fastening patterns can reveal a lot about shipyards and shipbuilders. Due to its proximity to the Columbus Ironworks, *Jackson* contains primarily iron fasteners. Treenails are used solely to connect the bottom-strakes to the floors, creating a ratio of treenail to spike of 1:53 throughout the ship. In contrast, *Neuse* uses a pattern of three treenails for each spike for all strakes, wedged on the interior of the vessel. This consistent pattern creates a ratio of 3:1 throughout the ship.

Drifts are used in the same pattern for all floors, frames, keelsons, and deadwood on both vessels. The pins are driven through each timber into the previous one. Both vessels' frames have three drifts attaching them to adjacent frames, with three additional drifts attaching following frames, totaling six passing through each frame. This alternating method was used until the 20th century in North Carolina barges (Smith in Prep.). Eight late 19th century or early 20th century barges abandoned at Elizabeth City feature edge joined strakes using this method. Elizabeth City was a Confederate shipbuilding center and Martin & Elliot, builders of the *Albemarle*, constructed flatboats, or barges, there before the war (Maffitt 1880:501). Elliot described this fastening method in the *Albemarle* article that he wrote after the war (Elliot 1888:421).

On *Neuse*'s bilge stringers, drifts with washers are used. *Jackson*'s primary stringer is attached to both the floors and frames in an alternating pattern. Iron drifts require a team to drive in place due to their size, indicating a number of laborers, though perhaps unskilled, were required for placing each floor, frame, and deck beam. Spikes, as well, required a two-handed hammer to drive, meaning two individuals were needed. Hundreds of laborers were required for the many iron and wooden fastenings in the ironclads.

The joinery is more sophisticated on *Jackson* than on *Neuse*. The Kinston gunboat contains only butt joints, except for horizontal scarphs on the keelplank and vertical scarphs on the keelson. In contrast, each primary structural component uses scarphs on *Jackson*. The bilge keelsons use a combination of vertical scarphs in the forward end of a timber together with a horizontal scarph in its aft end. Figure V.1 shows stringer timbers connected by a hook scarph, while the inboard edge of the same timber is connected to the rider floors with stepped scarphs. *Jackson* is the product of shipbuilders such as Charles Blain, the head civilian shipwright, who had constructed steamboats for the Chattahoochee River before the war (Mueller 1990:99).

FIGURE V.1. *Jackson*'s complex joinery (Photograph by author, 2009).

Structural Components

The keelplank is clearly defined on both *Neuse* and *Jackson*. On each vessel, the plank does not function as a significant structural component. Other than as an attachment for the posts and limber holes and to establish the ship's centerline, the keelplanks serve little function though larger than the surrounding strakes.

The use of sweet gum for *Neuse*'s keelplank is an interesting choice, considering pine was used for nearly all timber on both vessels, including *Jackson*'s keelplank. The gum keelplank is also narrower sided than the surrounding strakes, while *Jackson*'s is larger. These two differences are a clear suggestion of diverging bottom-based techniques in the Neuse and Chattahoochee river basins. As the first timber laid, the choice of size and wood type is local preference or based on available material.

The bottom-strakes on both ironclads are nearly identical. All are laid flush with butt joints. The ends are sawn to the shape of the vessel, common in North American bottom-based construction. The dowels in *Jackson* are similar to spijkerpennen on Dutch bottom-based ships, used to hold cleats from below (Hocker 1991:174). These fasteners are comparable to staging nails, used in modern wooden shipbuilding, that temporarily join timbers until the primary structure is in place (Ruhlman 2002:120). Dowels are absent on *Neuse*, perhaps indicating it was temporarily fastened from above. Alternatively, the dowels could have been removed and spike or treenails driven through the holes, as seen in some dowel holes on *Jackson*. Non-penetrative methods could also explain *Neuse*'s lack of dowels, such as rope or wooden blocks staying the strakes while they were cut.

While the scantlings of the strakes on both vessels are similar, the method of assembly differs. *Neuse* primarily uses stealers rather than strakes that run the full length of the vessel. Curves are easier to form in this manner. Interestingly, this differs from the full run strakes on both *Jackson* and *Albemarle*, seen in photographs following the war, such as Figure V.2. Both ironclads' strakes taper from bottom to top, with the thickest at the chine.

The pin-knuckle timber is the single feature on *Neuse* with craftsmanship superior to that on *Jackson*. On the Columbus ironclad, the bottom strakes and strakes are adzed to meet with no transition, or pin-knuckle, timber. On *Neuse*, the chine transition is strengthened by a pentagon shaped pin-knuckle attached with spikes to both strakes as well as floors and frames. In *Jackson*'s rebuilt stern, a heavy timber is used for this transition. This bottom strake extends beyond a normal pin-knuckle timber, but it is not adzed to fit on an angle, creating a stronger transition.

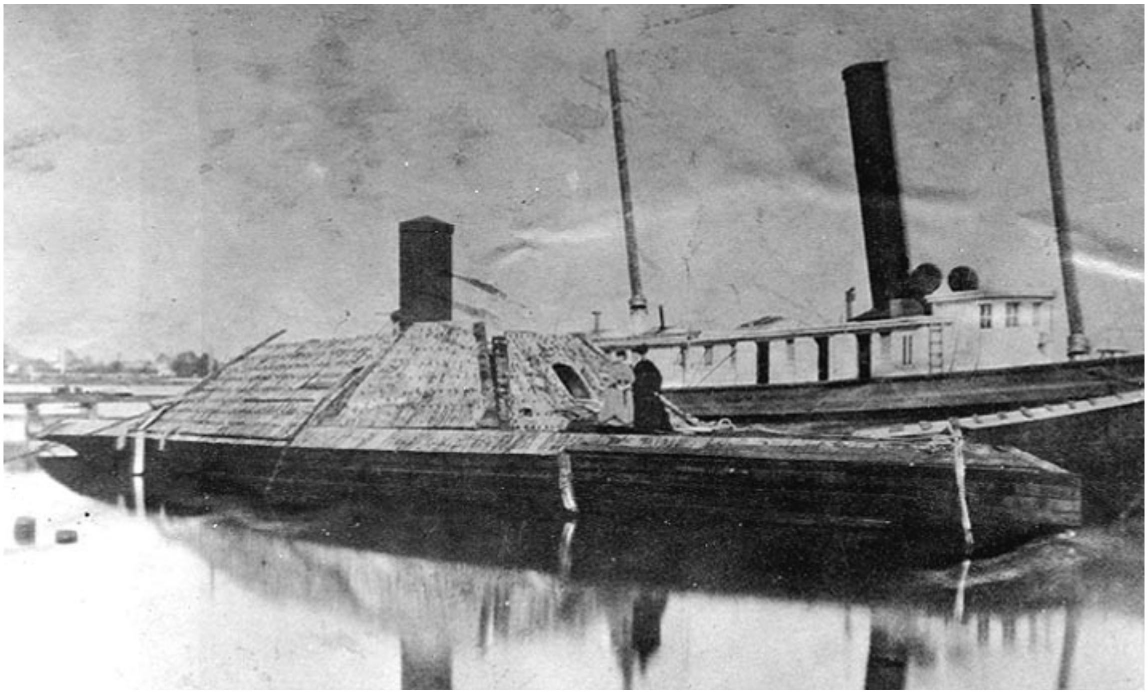

FIGURE V.2. *Albemarle*'s uppermost strakes, without any stealers, are visible in this photograph (Naval Historical Center 1865:NH63375).

The full floors and frames on both vessels are identical, as well as on *Albemarle*, suggesting it was a standard design on diamond hull ironclads. They are joined to the keelplank and bottom-strakes from below using spikes and treenails. Connecting the floors to the frames are half-laps joints. Found in houses and barns, the half-lap is used in shipbuilding through the 20th century, such as on a Pasquotank River barge (Smith 2010). Each floor and frame is connected to the timber preceding it with drifts, building outward from the master frames. In this method, the floors are shaped to the bottom and the frames attached to them, giving the vessel its shape, rather than battens.

The Confederate navy adopted the use of this floor and frame system relatively late. Earlier ironclads laid down by the navy, such as *Richmond* and *North Carolina*, used traditional framing systems (*Official Record of the Navies* 1[8]:207; Watts 1999:25). The account of Gilbert Elliot, constructor of *Albemarle*, shows full frames to be standard on the diamond hulls (Elliot 1888:421). The diamond-type's full frames likely originated from one of two circumstances. The first is the Tift brothers' *Mississippi*. Though the Tift brothers did not have naval experience, they were friends of Secretary Mallory and continued to work for the navy department throughout the war (McBlair 1880:598, Underwood 2005:12). The full frames with house carpenter joinery were likely adopted to speed construction by utilizing non-skilled labor, since ship carpenters were in short supply. These are the same reasons the Tifts adopted the method on their ironclads. While diamond hull ironclads use the Tifts' full frames, they do not feature the curveless design of *Mississippi*, instead keeping the curves of Porter-designed ironclads (McBlair 1880:598). When inspecting *Neuse* in February 1864, Robert Minor noted Asa Tift working there; though it is unclear if he was in a shipbuilding capacity, since Asa left for Georgia to check on iron plate (Bright et al.:1981:11).

Alternatively, the navy was already progressing toward substantial framing systems throughout the first year of the war. On frame-based vessels, fillers were placed in the room and space to strengthen the vessel from projectiles (*Official Records of the Navies* 1[8]:207). The simplicity of the diamond type design simply allowed shipbuilders to forego the fillers and edge join the frames. The fastening pattern was common in edge joined bottom-based construction, as shown by the barges in the Pasquotank River. The presence of cant frames to create curvature in the bow shows changes to the Tifts' lack of curvature, perhaps lending credence to this method.

On ships lacking a keel, the keelson is the largest centerline longitudinal timber. *Jackson*'s keelson did not originally extend the ship's full length due to the wheel well, but it was extended during the conversion to propellers. *Jackson* also features a rider keelson and two bilge keelsons not found on *Neuse*, showing the Columbus ironclad to be far heavier built. *Neuse* has a stealer bilge keelson, twenty-five feet (7.62m) long amidships. Bilge keelsons are common on flat, or near flat, bottomed ships such as western steamboats and the Crimean floating batteries (Kane 2004:63; Holcombe 1993:5), as the timbers dissipate still water oscillations, important for vessels in sheltered water (White 1900:177). Both vessels attach these keelsons using drifts driven from above. On *Jackson*, bolts with washers are also driven through the keelson from above.

While there are minor differences, chine assemblies on *Neuse* and *Jackson* are similar to the standard chine found on western river steamboats (Kane 2004:101). The sharp transition from flat bottom to angled sides requires heavy reinforcing, while the lack of a keel requires internal longitudinal strength. The chine assembly accomplishes these goals. The evolution of the chine assembly is likely from chine logs. Early western river steamboats used chine logs, while later ones switched to standard chine assembly (Kane 2004:102). It is likely that the large chine logs were replaced by easier to manufacture, maintain, and repair chine assemblies.

Neuse uses a clamp to hold the deck beams in place, which is likely the same system used on *Jackson*, though this area disappeared in the 1865 fire. Early war designs and descriptions use hanging knees (Holcombe 1993:75; Peebles 1996:27), the traditional method of supporting deck beams. Knees were difficult to manufacture, as they required a natural curve and a carpenter to work it. The straight timbers of a clamp were far easier to manufacture and install. No fastenings exist on the upper extremity of *Jackson*'s frames as would be found if knees were used; the *Missouri*-class plans show a clamp assembly composed of six pieces (Porter 1862a). On the smaller *Neuse*, the clamp assembly is composed of four timbers. Interestingly, on the *Missouri*-class plans, deck beams rest higher on the clamp than *Neuse*, where the ends meet the point of the knuckle. Unfortunately, the fire left no way to ascertain if *Jackson*'s clamps were built according to the plans or similar to *Neuse*.

Problems with *Jackson*'s clamp extend to the deck beams as well. *Neuse*'s deck beams mimicked the floors and frames with no room and space. Conversely, the *Missouri*-class plans show space between each beam. The casemate was built onto the frames and deck beams. Casemates on both vessels are typical of Confederate construction. The layers of pine, oak, and iron are the same as in *Virginia*. Differing from the earlier ironclads, the casemate's broadside panels extended directly from the knuckle, creating the diamond shape. *Neuse* had five gunports at either end, allowing each Brooke cannon to fire forward, from two quarter panels, or on either broadside. *Jackson* featured two pivot positions at either end due to the beam, along with adding a pair of broadside guns, totaling six cannon.

The bow assembly is a diagnostic feature of frame or bottom-based construction. It is unfortunate that *Jackson*'s bow did not survive, as *Neuse*'s reveals a lot about diamond hull ironclads. Lacking a true stem, the transition from the flat bottom to the angled bow is made by a compass timber, the only non-straight timber in the vessel. The compass timber is supported by deadwood above and aft. This simple construction differs from the earlier navy-built ironclads, discussed in the next section.

The stern assembly of *Neuse* and *Jackson* is revealing in their similarities as well as their differences. The heavily built sternpost and rudderpost are unlike western river steamboats and more suggestive of ocean-going ships. The frames, futtocks, and top timbers used in *Jackson*'s stern are identical to frame-based construction, though the strakes are formed and attached differently. The incongruous stern is likely the most complex aspect of the vessels and required by the propellers. Above the water, *Neuse* featured a transom stern, utilizing easy to obtain straight timbers. Conversely, *Jackson*'s fantail stern is harder to construct, but appears to have been popular with late war ironclads.

The internal components of both vessels were destroyed by ill advised salvage efforts. The 1960s salvage destroyed many interior bulkheads. Photographs and an 8mm film from the *Neuse* salvage show a combination of load bearing stanchions and bulkheads throughout the vessel. Western river steamboats often used bulkheads for longitudinal strength, but *Neuse*'s differ in that they support the deck and casemate.

The machinery in both vessels is the product of Southern attempts at speed and replication of popular technology. The exposed paddlewheel had obvious limitations in naval combat, leading to adoption of the recently designed, and better protected, propeller. *Jackson* attempted to use readily available inclined steamboat engines, positioned on the deck. After dismal performances by other paddlewheel ironclads, the switch to propeller was made (Holcombe 1993:49; Jeter 1987:275). Nearly all attempts to power ironclads like western river steamboats were failures, confirming earlier results of martial selection showing the superiority of propellers. Propellers were not favored for river and shallow draft use due to snags and submerged barriers, but naval action required it. This created an interesting hybrid power system. Ironclads used horizontal engines with propellers like ocean-going steamers, but operated in the shallow draft areas of western river steamboats.

Comparison Between *Albemarle*-Class and *Richmond*-Class Ironclads

The Wilmington ironclads, *Raleigh* and *North Carolina*, are *Richmond*-class vessels laid down in the spring of 1862 in shipyards of Cassidy & Sons and Beery & Brothers, respectively (Peebles 1996:31). *North Carolina* was launched in September 1862 and *Raleigh* in spring 1863. Both were fitted with engines, iron plate, and ordnance by the spring of 1864. Fortunately, both ironclads have been the focus of archaeological investigations (Peebles 1996), including a thorough structural analysis on *North Carolina* (Watts 1999).

North Carolina's coastal ironclads are strikingly different from the inland *Albemarle*-class. Comparison is possible through historical sources on *Albemarle* and the remains of *Neuse*. *Albemarle* and *Neuse* were laid down in the fall of 1862, in purpose-built inland shipyards at Edward's Ferry and Whitehall. *Neuse* was launched in March 1863 and *Albemarle* about the same time. *Albemarle* was fitted out at the naval station in Halifax, as *Neuse* was in Kinston (Elliot 1888:421; Bright et al. 1981:9). *Albemarle* and

Neuse were commissioned by April 1864 (Bright et al. 1981:14). While these dates parallel the Wilmington ironclads, the construction process was much different.

North Carolina's use of a keel, curved bilge, and sistered frames guiding the vessel's shape are frame-based traits. *North Carolina* has a length between perpendiculars of 150.6 feet (45.9m), a 33.5 foot (10.2m) beam, and thirteen foot (3.96m) draft (Watts 2006:6). *Neuse*, in comparison, has a length between perpendiculars of 136 feet (41.45m), 35.5 foot (10.82m) beam, and 7.5 foot (2.29m) draft. *Neuse*'s displacement, 948 long tons, is far exceeded by *North Carolina*'s 1467 long tons, despite roughly similar length and beam. Specific features further illustrate the differences between frame-based versus bottom-based construction.

The framing method differs between the coastal and inland ironclads. To begin, *North Carolina*'s frames fasten into the keel rather than into floors fastened onto a bottom panel. As previously examined, the diamond-type ironclads use straight timbers for floors, frames, and top timbers fastened into the preceding frame sets. The *Richmond*-class, conversely, uses curved timbers, a combination of floors, half floors, and futtocks (Watts 1999:25). Examination of the remaining structure shows that *North Carolina* has common frame-based traits.

The construction matches *Richmond*'s description of "Frames are 2 feet apart from center to center…Filled solid between the frames with yellow pine, fore and aft" (*Official Records of the Navies* 1[8]:207). The solid pine timbers are fillers used to strengthen the ship, but are distinguished from the actual frames. As a non-structural element, the fillers would have been added after the frames instead of concurrently.

Albemarle, conversely, had its master frames installed and then "other [frame timbers] were then bolted down to the keel, and to the one first fastened, and so on, working fore and aft…When this part of the work was completed she was a solid boat, built of pine frames, and if caulked would have floated in that condition, but she was afterwards covered with 4-inch planking…as ships are usually planked" (Elliot 1888:421). In appearance, *North Carolina*'s frames and fillers would appear similar to *Albemarle*'s abutted frames, as shown in Figure V.3, though constructed in a different manner. Elliot appears to acknowledge the unorthodox framing method by stating the planking was traditional.

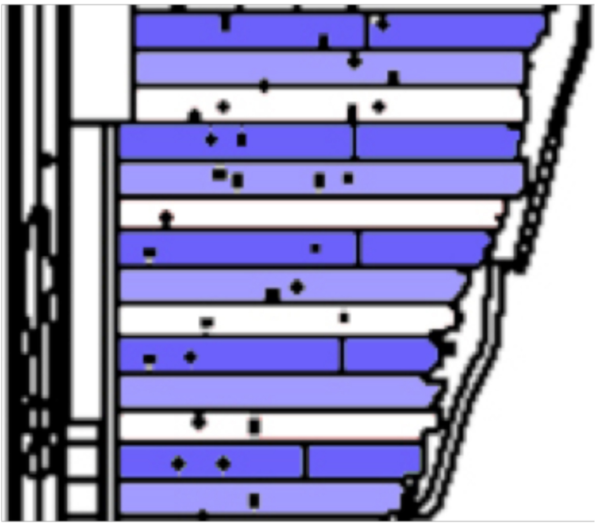

FIGURE V.3. Framing pattern on *North Carolina*, shading by author (Watts 2006:13).

North Carolina's lack of room and space likewise appears similar to *Neuse* (Watts 1999:25); though the shipbuilding process is more like *Richmond*. Watts hypothesizes the framing might be similar to *Neuse* and *Jackson*, though this cannot be confirmed without dissembling the hull (Watts 1999:26). This assumption is likely formulated using analogy, but this thesis presents evidence that the construction process between the coastal and inland ironclads is not similar enough for analogy. Rather, *North Carolina*'s framing pattern likely incorporates fillers similar to *Richmond*'s description.

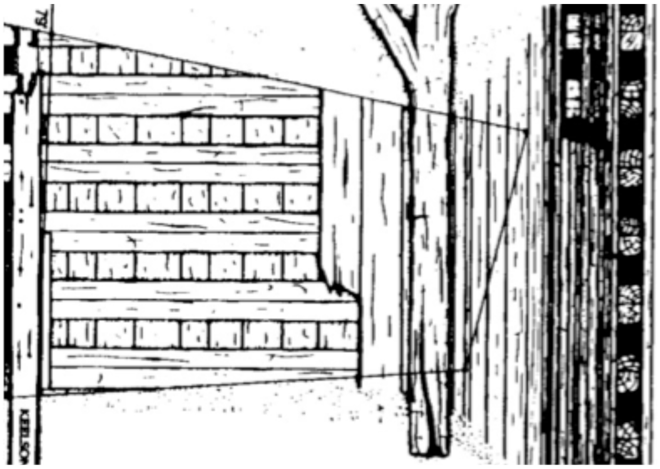

FIGURE V.4. Framing pattern on *Chattahoochee* (Watts et al. 1990:34).

Evidence for *North Carolina*'s filler use is shown by the similarity between other frame-based ships. The framing pattern without the fillers is a standard sistered pattern, also seen on the Confederate gunboat in Chicod Creek (Babits 1981) and *Chattahoochee*, seen in Figure V.4 (Watts et al. 1990:40). The space between centers on *Richmond* is twenty-four inches (61cm); on *Chattahoochee,* it is twenty-four inches (61cm) (Watts 1990:40), removing the hypothesized fillers on *North Carolina* would make this distance between 21.5 (54.6cm) and twenty-five inches (63.5cm) (Watts 1999:25). Six months later, the diamond-type ironclads replaced the multiple timber framing system with the easier to build, and stronger, full frames.

The ship-built *North Carolina* shows a length to beam ratio of 4.5:1, while the bottom-based *Neuse* has a 3:1 length to beam ratio. *Neuse* was built fuller, with a greater beam than *North Carolina,* even though it was shorter. *North Carolina* is built finer, with a draft seven feet deeper than *Neuse*, a trait common for ocean-going ships. Interestingly, Porter's construction plans for *Neuse* show a length to beam ratio of 4.5:1 (Porter 1862b:5). This provides quantitative evidence that contractors changed navy plans for local practices and conditions, while also confirming the primacy of the physical record over historical. Gilbert Elliot's measurements of *Albemarle* likewise differ from Porter's plans, indicating a 3.3:1 ratio (Elliot 1888:420).

Cargo ships are typically built like a box, while warships are built as long platforms for soldiers or guns (Steffy 2006:10-11). Therefore, warships generally have large length to beam ratios and workcraft are boxier. A larger ratio indicates finer lines, better ocean stability, and, traditionally, better performance (White 1900:474; Carmichael 1919:41). *North Carolina*'s ratio reflects its ocean trading shipbuilders, while *Neuse*'s is reminiscent of inland utility shipwrights. The length to beam ratios show construction differences as well local shipbuilders altering Porter's plans.

Slow Cargo Vessels..........................	0.80
Ordinary Cargo Vessels....................	0.75
Sailing Vessels.................................	0.70
Older Battleships.............................	0.65
Later Battleships..............................	0.60
Mail and Passenger Steamers...........	0.60
Cruisers...	0.55
Fast Cruisers....................................	0.50
Destroyers..	0.45
Steam Yachts..................................	0.40

TABLE V.1. General variations in block coefficients by ship types (Carmichael 1919:41).

A block coefficient is the ratio between the volume of the ship underwater and a block composed of the length, beam, and draft underwater. Similar to the length to beam ratio, the block coefficient indicates if a hull is full or fine, allowing a general comparison to other craft (Carmichael 1919:41). *Neuse*'s block coefficient is 0.72, comparable to an ordinary cargo ship or a sailing ship, as shown in Table V.1. *North Carolina*'s block coefficient, by comparison, is 0.645. This number is typical for seagoing warships from this period.

Comparison of the bows of *North Carolina* and *Neuse* illustrates the major construction differences, as shown in Figure V.5. *North Carolina*’s bow demonstrates traditional shipbuilding, using curved timbers, regularly spaced cant frames, and a structural stem. *Neuse*’s angular bow is simplified, using a single compass timber for the transition, but otherwise straight timbers (Watts 2006:15). The compass timber might be called the stem, but it is not a significant structural element, as it extends only two feet (60.9cm). Stacked deadwood provides the main structure of the bow, including the ram.

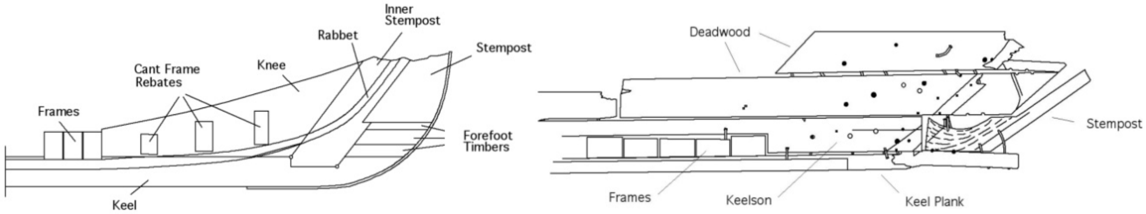

FIGURE V.5. Construction of the bows on *North Carolina* and *Neuse* (Watts 2006:15).

Diamond type ironclads were the result of a movement toward simplification for shallow operating conditions and inland construction. Brooke noted that the “the vessels of the enemy must be built for sea whilst ours need only navigate the southern bays rivers etc” and the shipbuilding program attempted to build ship of this model (Brooke 2002:34). The curved timbers for knees used on earlier ironclads, including the *Richmond*-class and *Tennessee* (II)-class, as shown in Figure I.2, required a great deal of time to locate and manufacture (Holcombe 1993:75, Peebles 1996:27). A straight clamp used on diamond type ironclads needed neither skill nor time to build. Other changes in addition to those discussed above, such as a flared knuckle instead of a built-on knuckle and an integrated ram, allowed unskilled labor to quickly produce these ironclads. In fact, these changes extended the navy's policy on simplicity, a strategy that began with the casemate's adoption in 1861.

The six months between the construction of the *Richmond*-class and *Albemarle*-class is the most telling of any period in Confederate shipbuilding as standardization and simplification intensified. As discussed earlier, loss of the naval yards and shipbuilding centers during this six month period heavily influenced Confederate shipbuilding. Though both the *Richmond*-class and *Albemarle*-class were both standardized designs for harbor and coastal defense, the conceptual approach to construction differs greatly. As discussed earlier, the first five ironclads were offensive weapons, each designed differently, with the exception of the sister ships *Arkansas* and *Tennessee* I. Following the loss of these ships in 1862, Porter rapidly introduced standard designs in 1862, first with the *Richmond*-class, and then he lengthened and improved the *Richmond*-class, to create the *Tennessee* (II)-class (Holcombe 1993).

The 1862 ironclads are similar to *Arkansas*, but with an angled casemate as a result of Brooke's armor testing. Porter likely designed the *Albemarle*-class as a response to the Union capture of the North Carolina sounds. Designed following *Richmond*, the diamond-type ironclads are a third generation simplified further for inland construction. The differing construction methods between the coastal and inland ironclads is hardly surprising, as two separate environmental conditions and types of shipbuilders were used.

Influences on Design and Construction

Neuse and *Jackson* show specific features that can be ascribed to Porter's novel design, vernacular shipbuilding, western river steamboats, and bottom-based construction. The hybrid construction is a product of the war, bypassing the regular development and adoption process.

Novel Design

Neuse and *Jackson* are the products of Confederate naval progression through three short generations. Porter's design incorporates successful features, such as angled armor, full frames, and straight timbers. New concepts were added, such as the flat bottom, replacing knees with clamps, and twin propellers. Lieutenant Warner commented that, "The method of construction adopted in the *Jackson*…although not in accordance with the best practice of naval architecture is nevertheless a very strong form, and well adapted for this purpose. The advantages of using straight timbers would contribute to a speedy completion" (Holcombe 1993:133). Warner appeared confident that, for its operational environment, *Jackson* would be a success, though non-traditional. The Confederacy's situation required adaptability, and attempts to construct a modern warship required non-traditional means. Interestingly, the Confederacy achieved similar use of non-skilled labor and straight lengths of material that assembly line industrialists used for early 20th century shipbuilding. While the 20th century industrialists used these methods to increase profit, the Confederacy took these measures due to lack of industry. These methods increased production speed, as *Arkansas* required eight months from contract to launching, while *Neuse* required five to six months, despite damage from the Union raid (Holcombe 1993:39,43).

While construction plans only detail a few general timbers, archaeology reveals particular construction features that appear in both vessels, suggesting they are designed. The full frames and alternating fastening pattern appear to have been preferred by the navy for ease of production. Diamond hull ironclads show distinct attempts by Porter to simplify construction, such as the substitution of clamps for knees. The general dimensions and layout of the vessels, together with the framing method, can be ascribed to Porter's design, but ship construction was the domain of the local shipbuilders.

Vernacular Shipbuilding and Local Innovation

Local techniques can be found through comparison. Porter's history suggests he planned the ironclads to be frame-based. For instance, the length to beam ratio on *Neuse*'s construction plans is more similar to a frame-based than bottom-based ship. He also stated that *Albemarle* was poorly constructed, perhaps referring to the method, though possibly the materials used. (Still 2008: 123). Additionally, Porter gives hold depth to the keel rabbet, traditionally used in frame-based plans, since there is no actual rabbet on the keelless *Neuse* and *Jackson*. The physical record indicates non-traditional techniques were used.

Driving fasteners from below, or building the bottom upside down and flipping it, is local technique common in the South (Merriman 1997:15). The builders' differing approaches to the keelplank, chine assembly, pinknuckle timber, and fastening pattern suggest distinct local traditions in North Carolina and Georgia. Given Mallory's instructions to construct ships using familiar methods as quickly as possible, shipbuilders used traditional techniques utilized before on smaller merchant or utility vessels in the new warships. The vessel type many shipbuilders were familiar with was the western river steamboat.

Western River Steamboat

By 1861, the western river steamboat was the proven workhorse of inland waterways (Kane 2004:16); and, the author argues, had become a distinct shipbuilding tradition. This tradition clearly influenced *Neuse* and *Jackson*, specifically the standard chine assembly and interior bulkheads for strengthening the upper deck. *Jackson*'s straight run, as well as its first set of engines and the paddle wheel, were clearly influenced by western river steamers. While these traits are immediately identifiable, *Neuse* and *Jackson* lack several key characteristics of western steamboat construction.

This steamboat tradition's primary structural strength is derived from iron trusses. The absence of hogging trusses indicates these ironclads are a separate, variant, construction type. The depth of hold and engine location conflicts with western river steamboats. The noticeable steamboat traits indicate an influence, but the omission of the most significant steamboat characteristics demonstrates the ironclads were not built as armored western river steamboats.

Bottom-Based Shipbuilding

The conceptual approach to building *Neuse* and *Jackson* is bottom-first, evident in the assembly order and structural systems. The ironclads share the characteristics of North American bottom-based vessels indentified by Hocker, having, "flat, keelless bottoms assembled as panels and then cut to shape. Posts and floors are fastened to the upper surface of the bottom… Side planking, frequently thinner than the bottom planking, meets the bottom at a hard chine," which, importantly, makes these vessels "bottom-based in the purest sense; the bottom is not only the basis of design and the first part constructed, but also structurally distinct, with heavier planking and massive floors" (1991:224). In addition, the construction of the sides is guided by the bottom, rather than key frames, as it would in a frame-based method.

Non-traditional Old World techniques took root in the Americas far more than is acknowledged today. While large frame-based ships carrying colonists crossed the Atlantic, the passengers mentally carried their local shipbuilding traditions. Many shipbuilding traditions have been found in North America as a result of multinational immigrants. The Clydesdale vessel in South Carolina is similar to *Batavia* of 1628. Both illustrate the persistence of a hybridized construction, with half-frames installed after the bottom strakes (Amer and Hocker 1995:299; Gould 2000:232). It is therefore unsurprising that bottom-based shipbuilding took root in similar environmental conditions.

Bottom-based shipbuilding has a long history in North America, possibly including an indigenous tradition. Many archaeologists have overlooked the use of this shipbuilding method since it is non-traditional and uses techniques described as house carpentry, more akin to barn building. Smaller utility boats like scows and barges are often overlooked. The use of bottom-based methods for naval vessels is rare, leading researchers to miss the connection.

The structural system is distinctly bottom-based. The absent keel is marked by a structurally irrelevant keelplank, with the chine, keelson, and bilge keelson providing longitudinal support instead. The frames gain their shape from the bottom, rather than battens, as they would in a frame-based method. The techniques suggest that shipbuilders were familiar with smaller bottom-based river vessels similar to the Trent River flat, the Brown's Ferry vessel, the Cypress Landing scow schooner, the Mars Bluff skiff, and the Pasquotank River barge detailed earlier. A bottom-based tradition is also found in two other influences, vernacular shipbuilding and western river steamboats. For this reason, bottom-based construction is the primary influence found in *Neuse* and *Jackson*.

United States Navy

Changes in conceptual approaches to construction are not found in the United States Navy due to an established shipbuilding system. Frame-based construction provided ships with the widest operational range and had been used successfully for years, a factor heavily influencing the conservative admiralty. Several experimental ships, such as *Monitor* and the city-class ironclads were built with different conceptual models; however, these designs were changed to the frame-based model when fully adopted, such as the *Passaic*-class monitors.

Conclusion

Neuse and *Jackson* show a hybridization of common pre-war traditions. Both in assembly order and structural systems, the ships are bottom-based, clearly differing from the frame-based construction of coastal ironclads. The vessels show varying degrees of each of the four influencing traditions. Both vessels' gross anatomy is characterized by

Porter’s novel design. The full frames, boxy amidships, and simplified design are indications of this. Each shows traits consistent with local alteration in the case of vernacular techniques and local innovation. Household carpentry and small boat building techniques are the key indications. Western river steamboats heavily influenced both Porter’s design and the shipbuilders’ construction. The chine and stringer assembly, along with load bearing bulkheads are western steamboat traits, but the lack of hogging trusses and the deep hold show the vessels to not be primarily western steamboat design. The ships are bottom-built, the primary influence in their construction. Used since Late Antiquity, bottom-based shipbuilding traditions directly inspired Porter, local shipbuilders, and western river steamboats. It is difficult to separate aspects of these four influences precisely because bottom-based shipbuilding had been prevalent in the river systems since the early colonial period. Since it is the oldest and composes the structural system, bottom-based shipbuilding is the primary influence in the construction of *Neuse* and *Jackson*.

CHAPTER 6: SUMMARY AND CONCLUSIONS

Confederate shipbuilding did not arise from the rebellious fervor at the outbreak of the war. Instead, its practices can be traced to several existing pre-war traditions. The latest naval architectural ideas combined with local shipbuilding knowledge to create ships for the Confederate condition. Individual ships within the same class, such as *Albemarle* and *Neuse*, as well as *Missouri* and *Jackson*, differed due to local techniques and vernacular culture. Confederate shipbuilding is therefore not a single tradition, but as diverse as the interdependent industrial network that built the ships.

Confederate Shipbuilding

The shipbuilding changes during the fall of 1862 were based on a need for simplification. This led to angular ships without hanging knees, room and space between frames, or curved bilges commonly found in wooden shipbuilding before and after the war. These traits did not have continuity, as they would as a tradition, but are instead better labeled as a short term style. The drift fastening pattern continued to be used on utility vessels into the 20th century. The hybrid conceptual approach was not maintained and after the war, shipbuilders returned to their pre-war traditions.

Several coastal areas, such as Wilmington and Mobile, maintained frame-based construction methods throughout the war. The availability of traditional shipbuilders led to continuity of the frame-based conceptual approach to construction. *Phoenix*, a *Nashville*-class paddlewheel ironclad, was contract in March 1863 and built using frame-based methods with a curved bilge and timbers, such as hanging knees (Ball 1998:63,87-88). The ironclad was damaged during its launch and never used in battle, eventually being sunk as an obstruction. Mobile shipbuilders used a mix of traditions, as two vessels sunk with *Phoenix* were bottom-based, a flat and the chine log paddlewheel steamer *Cremona* (Ball 1998:71; Kane 2004:103). Additionally, the diamond hull ironclads *Tuscaloosa* and *Huntsville* were built there. Wilmington continued building frame-based ironclads, despite the fact *Raleigh* broke its keel on the shallow entrance to the Cape Fear River and the shallow draft of a diamond hull ironclad might have fared better.

It is no coincidence that more diamond type ironclads remain in the archaeological record than others. While the earlier ironclads saw action and possible capture or defeat, the diamond hull ironclads were coming off their stocks as the war ended. Additionally, their inland yards trapped several in the rivers where they were launched. Nearly all were scuttled, literally in the wrong place at the wrong time. Had *Neuse* been fitted out further down stream or not delayed a month by the Union assault on Whitehall, it might have entered the sounds. *Jackson* might have better served the Confederacy as a floating battery with a paddlewheel than an unfinished propeller gunboat.

The diamond type ironclad might be the most representative form of Confederate naval architecture. Three generations of ironclads led to this simplified harbor defense vessel uniquely formed for the Confederacy's industrial capability and the South's coastal waterways. Devised for mass production and simplistic manufacture, the diamond hull ironclad was the Ford Model T of the Confederate navy. The simplification mirrors later ship construction in the early 20th century. Had the Confederacy standardized engine manufacture with interchangeable parts, instead of custom making each, then contractors could have built the ironclads in four to five months, fitted them out in just a few months, and had ships battle ready within eight months. Additionally, had Mallory focused on completing a handful of ironclads in key locations, instead of attempting so many, the Confederacy could potentially have held key port such as New Orleans, Wilmington, and Charleston. Beyond the Confederate deficiencies, the United States did an excellent job blockading and coastal raiding, maintaining an extended war of attrition. In truth, Civil War naval warfare is often judged by Confederate missteps rather than recognizing the successful strategy and execution of the United States Navy.

Effectiveness of the Confederate Shipbuilding Program

Mallory's ironclad program must be viewed as a failure, since so few vessels were completed. Early in the war, Union forces were constantly vigilant and ships were diverted to confront the Confederacy's fleet-in-being, though the ironclads were usually still on the stocks. This period was a success, despite the inability to force a pitched battle with completed ironclads. Late in the war, the costly ironclads were ineffective at stopping encroaching Union forces. Mallory's fault is not in his planning, but in his trust of naval trends. The ironclad warship never performed as theorized for the Confederacy, Union, or European navies (Milligan 1984; Gould 2000:289). Without support troops or ships, the ironclads were exposed and ineffective.

In terms of warship development, the diamond hull ironclad is a significant branch, though ultimately a failure, as no later ships were based on them. *Neuse* and *Jackson*, together with their Union counterparts, *Cairo* and *Monitor*, are the oldest examples on display of steam warships without auxiliary sail. *Jackson* illustrates the shift from paddlewheel to propeller within a single vessel. Despite these successes, the ironclads could not overcome several faults.

The iron-plated wooden casemate design could not compete in the long term, due to instability and quantity of iron. The Union introduction of the XV-inch Dahlgren forced the Confederacy to increase layers of armor-plate, making large and medium sized casemates inadequately armored, or else too heavy and unstable with increased layers. The turreted ironclad in Columbus, Georgia, or the small double casemates of *Wilmington* were the only feasible designs to combat these large Dahlgrens, had the war continued. Rather than a step in a natural progression toward the modern warship, the casemated ironclad was a dead end. This evidence disproves unilineal cultural evolution, and to claim otherwise would be ex post facto history.

Further Research

The success and failure of ship designs, especially the transfer of certain features, warrants future research. The transfer of ideas among naval architects in the 19th century is a revealing case study with archaeological as well as historical sources. The late 19th century produced many such dead ends as naval architects attempted to integrate the new innovations of the industrial revolution. HMS *Ready* and HMS *Medway* are gunboats built only a few years after *Neuse* and *Jackson*. *Ready* was a composite, using iron frames to support wooden planking, an attempt to decrease fouling. The iron *Medway* was the brainchild of William Froude, using an oval shape to create a shallow draft. Each ship attempted novel designs for shallow drafted gunboats, but were dead ends like the Confederate gunboats. The database of ships from this period continues to grow, allowing more thorough analysis into the transfer of ideas. Further research into this important era will give insight into modern warships as well as the many failed methods.

Civil War naval research through archaeology has great potential. There are a plethora of excavated assemblages that rest in storage, unexamined and lacking interpretation. Even among sites examined by archaeologists, there are many with only descriptive analysis, a problem throughout cultural resource management and the relatively new field of maritime archaeology (Gould 2000:2).

While excellent historical scholarship has gleaned the written sources, amateur enthusiasts, cultural resource management, and historical particularist, or ideographic, archaeologists have dominated Civil War archaeology. Each group provides a product, often well thought out, based on their own goals. On average, these reports remain descriptive and narrowly focused. A number of Civil War vessels, including ironclads, have been located throughout the South, but only a handful have been extensively recorded by archaeologists. A nomothetic research design allows the interpretation of culture and behavior, providing a more detailed product than descriptive analysis. For example, a number of scholars claim archaeological examination of ships with construction plans is unprofitable, an argument this thesis categorically disproves (Gould 2000:8). The decentralized shipbuilding program gave local contactors free reign, making it unlikely that any two Confederate vessels are alike, despite Porter drawing only a handful of designs.

Conclusion

There remain archaeologists skeptical of researching cultural processes, intent on describing “arms” rather than the “tools” that created them. Thomas Carlyle, the philosopher, pessimistically contrasted the world of Virgil to the industrial world, asking, “For we are to bethink us that the Epic verily is not *Arms and the Man* but *Tools and the Man*- an infinitely wider kind of Epic” (Carlyle 1905:296). Thomas Carlyle, the salvager of *Neuse*, was likewise more interested in the arms than tools, but for profit rather than a fading Classical worldview. Regardless of the Carlyles’ philosophy and materialism, for archaeology the study of processes furnishes “thick description,” while study of the arms is only superficial. Examination of the knowledge, tools, and labor rather than the product results in a twitch becoming a wink. The construction process of the diamond-type ironclad reveals the technological, economic, and social structures of the Confederacy.

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