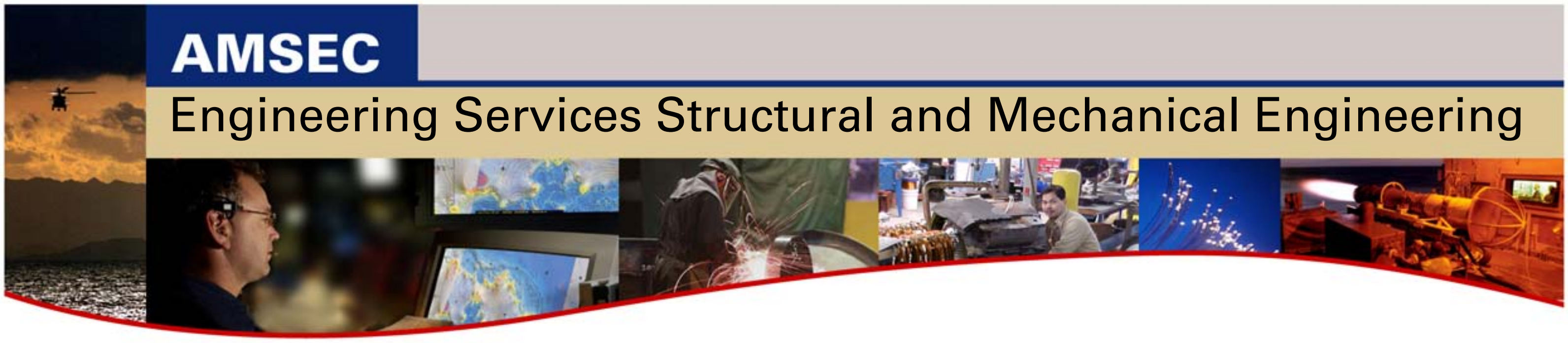
AMSEC

Engineering Services Structural and Mechanical Engineering



The structural and mechanical engineering department at AMSEC LLC provides engineering calculations for shock analysis, vibration, stress, fluid flow, HVAC, and power distribution for diverse customers, including private and public shipyards, the U.S. Navy, U.S. Coast Guard, private owners and operators, various government facilities, and commercial contractors. For finite element analysis, AMSEC uses NEiNastran®, version 9.0.5.505, developed and supported by Noran Engineering, Inc., and FEMAP®, version 10.2.0, Finite Element Modeling and Post-Processing Software for pre- and post-processing supported by Siemens. AMSEC is able to import components and structures from various software into FEMAP for visualization and manipulation purposes.

AMSEC's structural engineering projects:

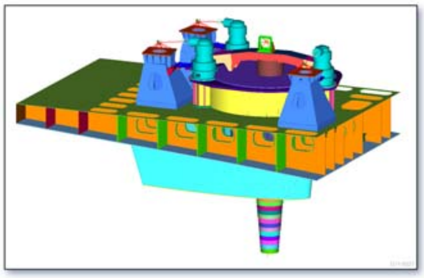
1. Engineered a 60-foot TAS XMTR antenna tower structure with platform and a 60-foot TAS RCVR antenna tower structure using 40 feet of existing GFE tower structure material. This was installed in Norfolk, Virginia.

2. Evaluated, under static shock loading conditions, the structural integrity of a Caley-designed boat davit and tow boom for LPD 17.

3. Evaluated, under static shock loading conditions while in the retracted position, the structural integrity of a Kingsbury-designed auxiliary thrust bearing for CVN 78. Three Finite Element (FE) models were constructed: one for each of two shoe assemblies and one for the journal sleeve bearing.

4. Evaluated, under static shock loading conditions, the structural integrity of a Kingsbury-designed line shaft bearing for CVN 78. An FE model was constructed to examine four static load conditions: two vertical and two athwart ship.

5. A finite element analysis was performed on the Steering Gear Actuation System (SGAS) for the module being built on DDG 1000. The SGAS is an electrically actuated ship steering system built on a structural module or plug, which will be lifted into place during ship construction and be integrated with the ship's stern structure. The structural plug measures approximately 21′-5 ½″ long by 16′-3″ wide at the first platform level. The extent of the SGAS model included the first platform deck structure, which is supported by floors connecting the first platform to the shell plating, three motor foundations, slewing and pinion gears, rudder angle transmitter foundation, rudder and rudder stock. The structure was analyzed for normal operating loads in accordance with the DDG 1000 ship's specifications. The structure was also analyzed for shock loading (DDAM analysis) caused by an underwater explosion in accordance with Design Data Sheet 072-1, Shock Design Values, Department of the Navy, Naval Sea Systems Command, dated September 15, 1972. Hull slamming loads, ships motion loads, and hull girder bending loads were applied as independent load cases to the finite element model. All bolts were analyzed for static and shock loads.



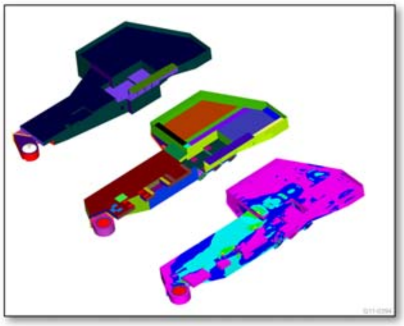
6. Performed a propulsion shafting alignment analysis on the Army Corps of Engineers' dredge Essayons. The propulsion system included five bearings: line, stern tube, and reduction gear shafting; hydraulic oil piping; shaft liners; fiberglass protective coating; servo box; a bull gear, and propeller.

7. Conducted a Finite Element Analysis (FEA) to ensure that the resonant frequencies for the proposed installation of a Ring Laser Gyro (RLG) foundation on the ex-USS Foster (DD 964) exceeded the manufacturer's 80-Hz requirement for the foundation.

8. Evaluated the new mission deck and crane foundation on T-AGOS 8.

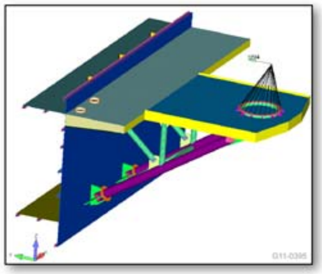
9. Provided design and engineering support for the Super High Momentum Spectrometer (SHMS) structures. The SHMS consists of five superconducting magnets that focus and steer particles to an arrangement of particle detectors. The detectors and electronics must be enclosed in a shield house, which protects them from radiation produced in Hall C during experiment operations. The shield house and the magnets are supported on a structure that provides precise positioning of the detectors and magnets at various angles from 5.5 to 40 degrees relative to the incoming electron beam. AMSEC recommended changes to decrease the overall weight of the support structure, combat design inefficiencies, and remove producibility issues. AMSEC also performed analysis to

eliminate overstress. The final product was broken down into subassemblies that could meet specific design limitations of access and crane capacity, as well as an additional requirement of reducing on-site construction time. AMSEC also produced a cost estimate to support the construction phase of the structure.

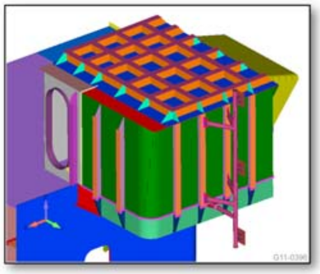


10. Performed various FE shock analyses on the following naval vessels:

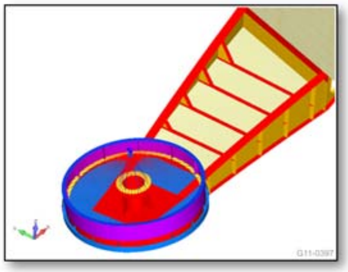
- USS John F. Kennedy (CV 67) — new RAM breakwater and AC plant foundations.
- LHD-class — MK 38 Mod 2 MGS platforms and foundations to ensure platforms met frequency and loading requirements. The latter included evaluating the platforms for frequency, shock, ship's motion with wind and ice loading, green water/wave slap, and air and gun blast.



- LHD-class — SPN 41 Platform Enclosure in support of Joint Strike Fighter modifications to ensure platform and enclosure met frequency and loading requirements. The latter included evaluating the platform for frequency, shock, ship's motion with wind and ice loading, and air and gun blast.

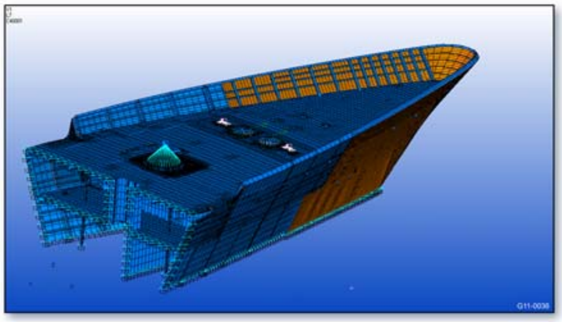


- USS Carl Vinson (CVN 70) — CBSP antenna sponson platform, antenna foundation, and radome foundation to ensure platform met frequency. Transient analysis of frequency response to shock and ship's motion with wind and ice loading was performed.
- USS Bataan (LHD 5) — mogas jettison platform and fire pump foundations.
- USS Bonhomme Richard (LHD 6) — AN/SPS-73 radar platform and foundation.
- USS Bonhomme Richard (LHD 6) — Ammunition locker platform and foundations to ensure platform and enclosure met frequency and loading requirements. The latter included evaluating the platform for shock, ship's motion with wind and ice loading, and air and gun blast.



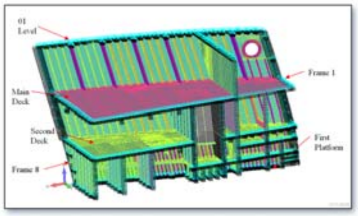
11. Developed an FEA of the main mast on the Prevail (TSV-1) to ensure the structural integrity of the mast.

12. Developed an FEA of the 57 Mk 3 Naval gun mount for USCGC Deepwater NSC. The 57-mm gun mount model was developed from the ship constructor model and converted to 3-D drawings in AutoCAD. Using FEMAP as the pre-processor, the geometry was imported from the 3-D drawings.



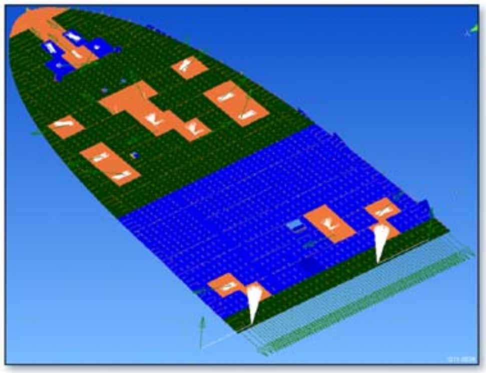
13. Performed the following studies for TAGM 25:

- The bow flare structure was analyzed during a slamming event. The hull girder and local ship structure of the bow and bow flare needed to have sufficient strength to



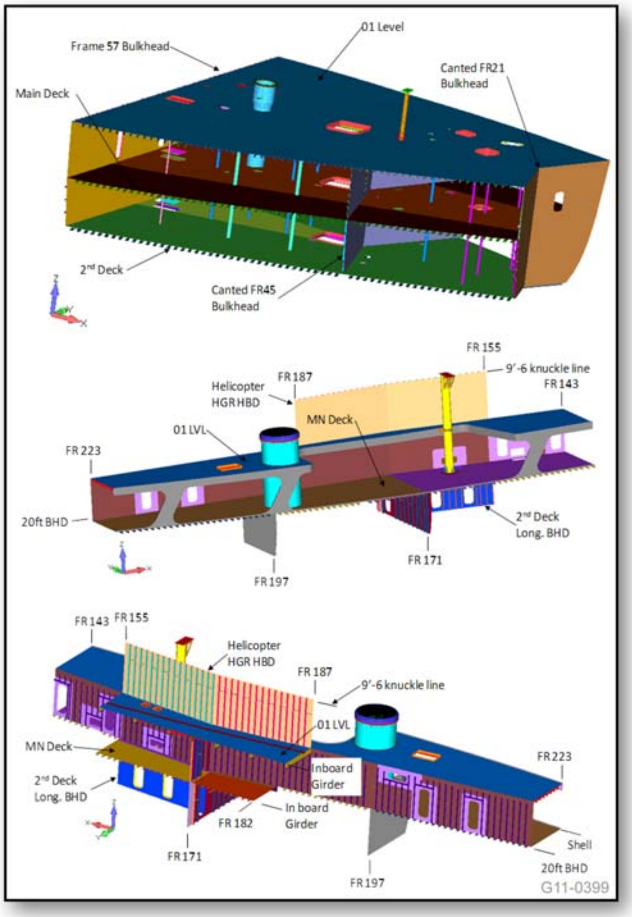
resist the effects of bottom and bow flare slamming. This analysis was conducted because of the results of model testing.

- An FEA was conducted for each mission radar installation. The model included the barbette, deck structure connected to the barbette, surrounding interior bulkheads, and shell of exterior deckhouse bulkheads. The focus of the analysis was to ensure that the strength and rigidity of the foundation system were in accordance with specified requirements.
- Due to the moderately long overhang of the hull beyond the skeg and the heavy weights of the rudder and steering gear, a model was made of the hull aft of the skeg. An FEA was conducted to verify the hull strength was within the allowable yield. Sea motion acceleration forces and static loads, including rudder torque forces, were applied.
- A model was made of the pumpjet well compartment to verify the strength of the structure supporting the pumpjet against the forces it generated. Static loads and sea motion acceleration forces also were included in the load package. An FEA was conducted to check the plate-field stresses to ensure the allowable yield strength of the material was not exceeded. The Finite Element Model (FEM) included the shell, bulkhead, and platform plate panels.
- The 01-level foredeck contains a large number of deck equipment, including the anchor windlasses; mooring winches, bitts, and chocks; foremast; deck cranes; and towing fitting. An FEA of the deck structure was conducted to develop an integrated deck stiffening system to handle the diverse loads imposed upon the deck structure by various pieces of equipment.



- An FEA was conducted on the lifeboats and their davits. The deck structure was examined to determine if the deck scantlings could withstand forces and moments produced by the lifeboat davits and related equipment without exceeding the yield strength of the material.
- An FEA was conducted on deck-access openings that included at least one opening bounded by bulkheads below and one bounded only by deck stiffeners. Those openings, located on effective hull girder decks, had hull girder bending moments and shear forces included as part of the plate loading. Deck FEMs were extended far enough out to a bulkhead/stiffener to minimize the effects of constraints on stress results. Shear flow forces were calculated from hull girder bending moments and shear forces. These forces, along with a uniform deck pressure, were applied to each FEM. The resulting stresses around the corners were examined to ensure no failure occurred.
- An FEA was conducted to determine structural adequacy in the space of FR 38-45 on the second deck. One of the primary structures to be analyzed was the cargo elevator pit, located halfway between the second deck and the first platform. The second deck FEM was built out to the nearest bulkheads to ensure that the effects of bending and shear on each deck section were modeled accurately. Runaway elevator and counterweight loads from an imposed loading diagram were used for a worst-case analysis. In addition, a wet-head pressure was applied to the second deck and trunk bottom with a uniform calculated head pressure along each trunk bulkhead.
- An FEA was conducted to determine structural adequacy at the corners of longitudinal bulkhead openings between the second deck and 01 level. The FEA was performed to ensure the radius used in the bulkhead cutout corners was sufficient to minimize stress concentrations.
- An FEA was conducted to determine structural adequacy of openings in the 01 level, first platform, second deck, and main deck and ascertain whether any overstresses existed in the corners. The FEA was performed to ensure that the corner radius (150 mm) was sufficient to minimize stress concentrations.
- An FEA was conducted to determine structural adequacy of various large foundations: AC plant, main propulsion motor, diesel generators, duplex strainers, anchor handling, tanks, line shaft bearing, thrust bearing, monorails, and stores cranes.

14. Provided analysis of existing ship's structure to support new 3- and 15-ton cranes on the U.S. Coast Guard Cutter Polar Star.



15. Provided shock engineering calculations and shock and vibration component reviews to ensure a component is compliant with Mil-S-901D and Mil-STD-167. For the past year, AMSEC has provided reviews of shock qualification documentation (i.e., test procedures, test reports, analysis, etc.) for compliance to the above standards. AMSEC engineering has been supporting the CVN 78 Shock Qualification Program in the following areas: shock qualifications, the review and writing of shock qualification procedures, analysis of HVAC foundations for shock, preparations of hangar shock qualification analyses, and the writing of shock qualification letters to SUPSHIPNN. AMSEC has provided reviews of vendor drawing and vibration extension packages (fan coil units, cooling coils, CRES r-valves, aluminum r- and k-valves, and vaneaxial fans) for technical/specification compliance, accuracy, clarity, and completeness. AMSEC has prepared shock qualification calculations for manholes and BERPs and shock extension packages for powered ramps and hatch ramps used in weapons and material handling.

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