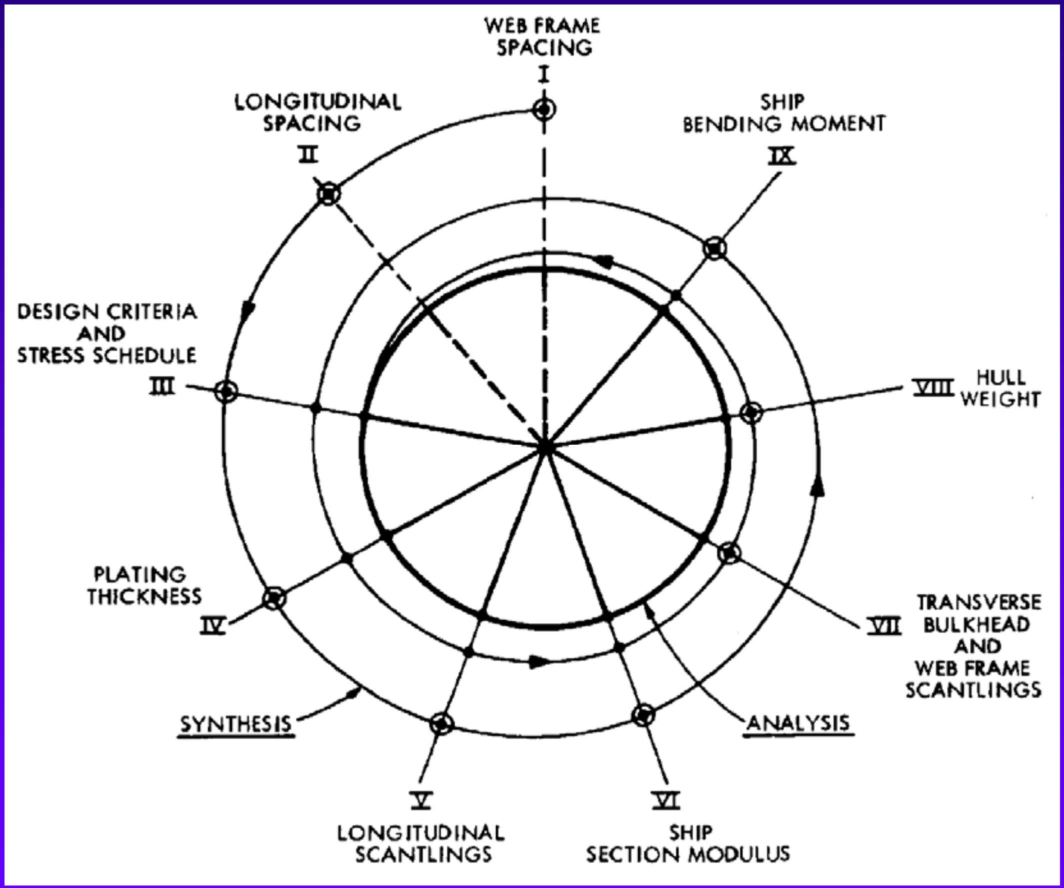
Primary Hull Laminate

PRIORITIZE DESIGN GOALS
Strength
Stiffness
Cosmetics
Cost



from Ship Structural Design Concepts by J. Harvey Evans

Primary Hull Laminate

PRIORITIZE DESIGN GOALS
Strength
Stiffness
Cosmetics
Cost

→

CONSTRUCTION
Solid or Sandwich
One-Off or Production

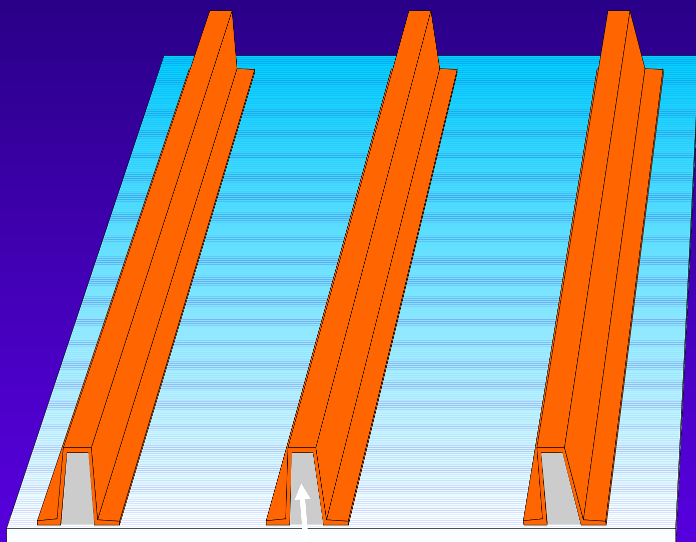
Determine general geometry and construction method

Primary Hull Laminate

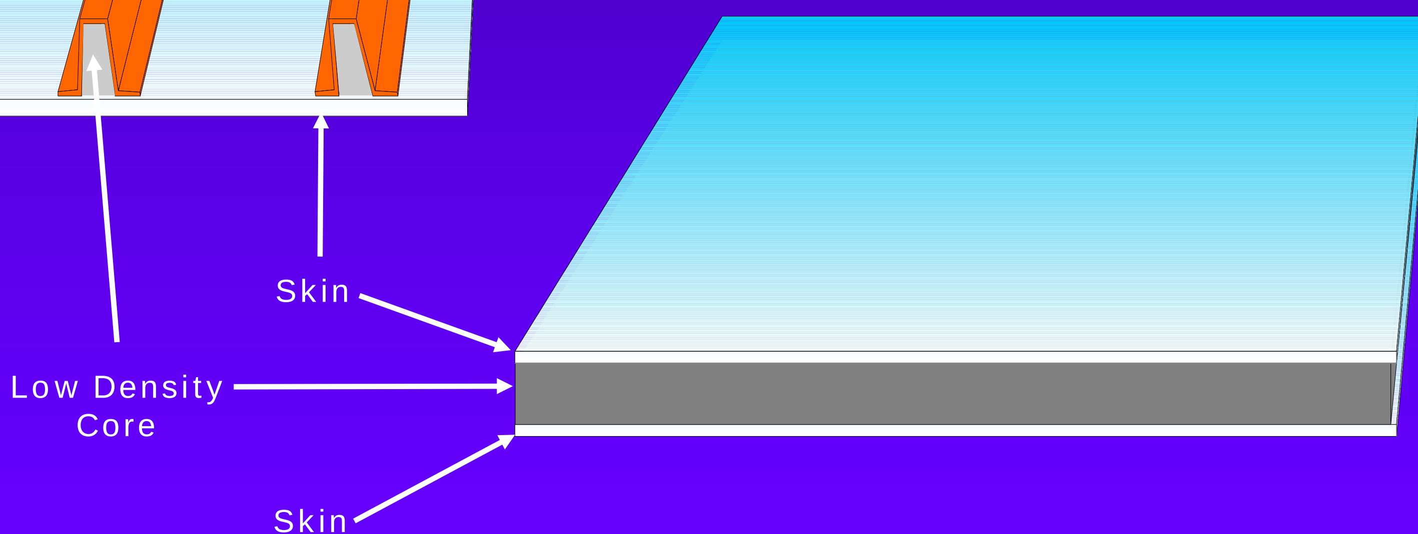
Comparison of Solid & Sandwich Laminates for Out-of-Plane Loads

	t	2t	4t
Relative Stiffness	100	700	3700
Relative Strength	100	350	925
Relative Weight	100	103	106

Hat-Stiffened Solid Laminate

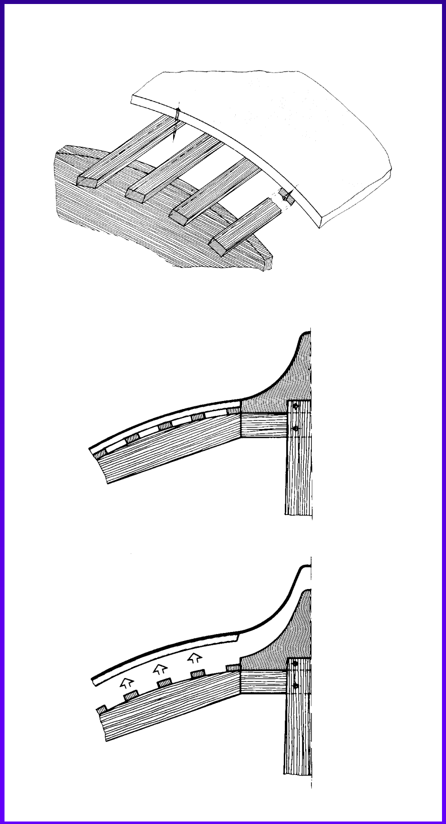


Sandwich Laminate

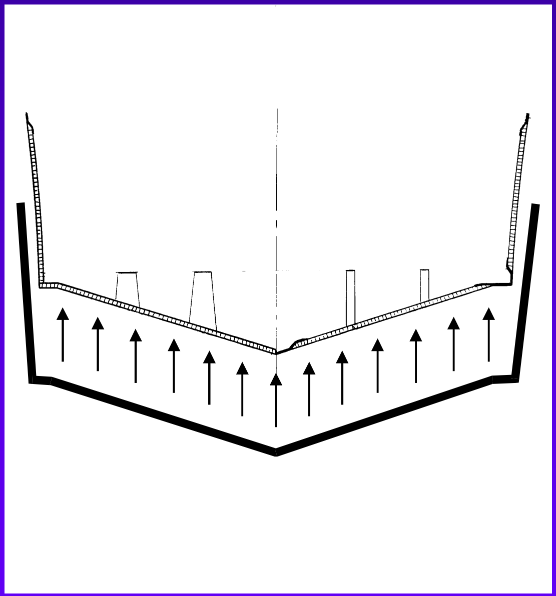


Primary Hull Laminate

One-Off Construction
Using Wooden Male Plug



Production Construction
from Female Molds



Primary Hull Laminate

PRIORITIZE DESIGN GOALS
Strength
Stiffness
Cosmetics
Cost

CONSTRUCTION
- Solid or Sandwich
- One-Off or Production

Determine general geometry and construction method

MATERIAL SELECTION
- Reinforcement
- Resin
- Core

1

Preliminary selection of constituent materials

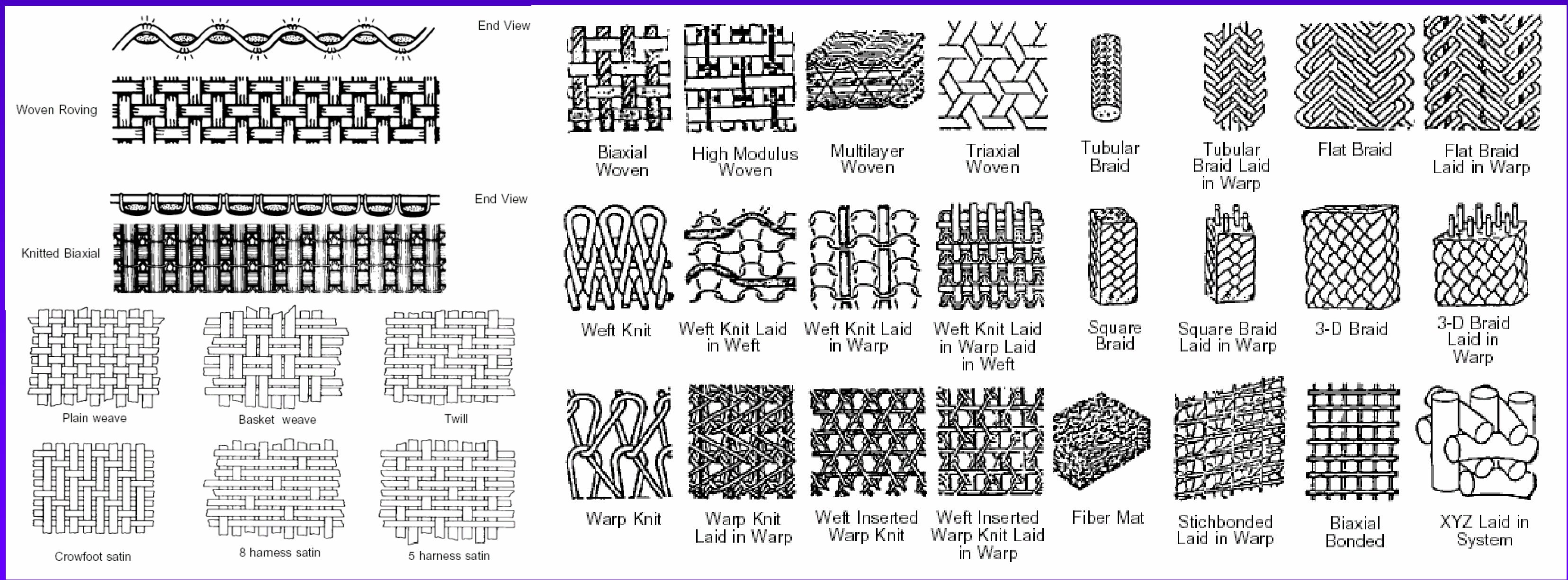
REINFORCEMENT
- Composition
- Architecture & Thickness
- Orientation

Primary Hull Laminate

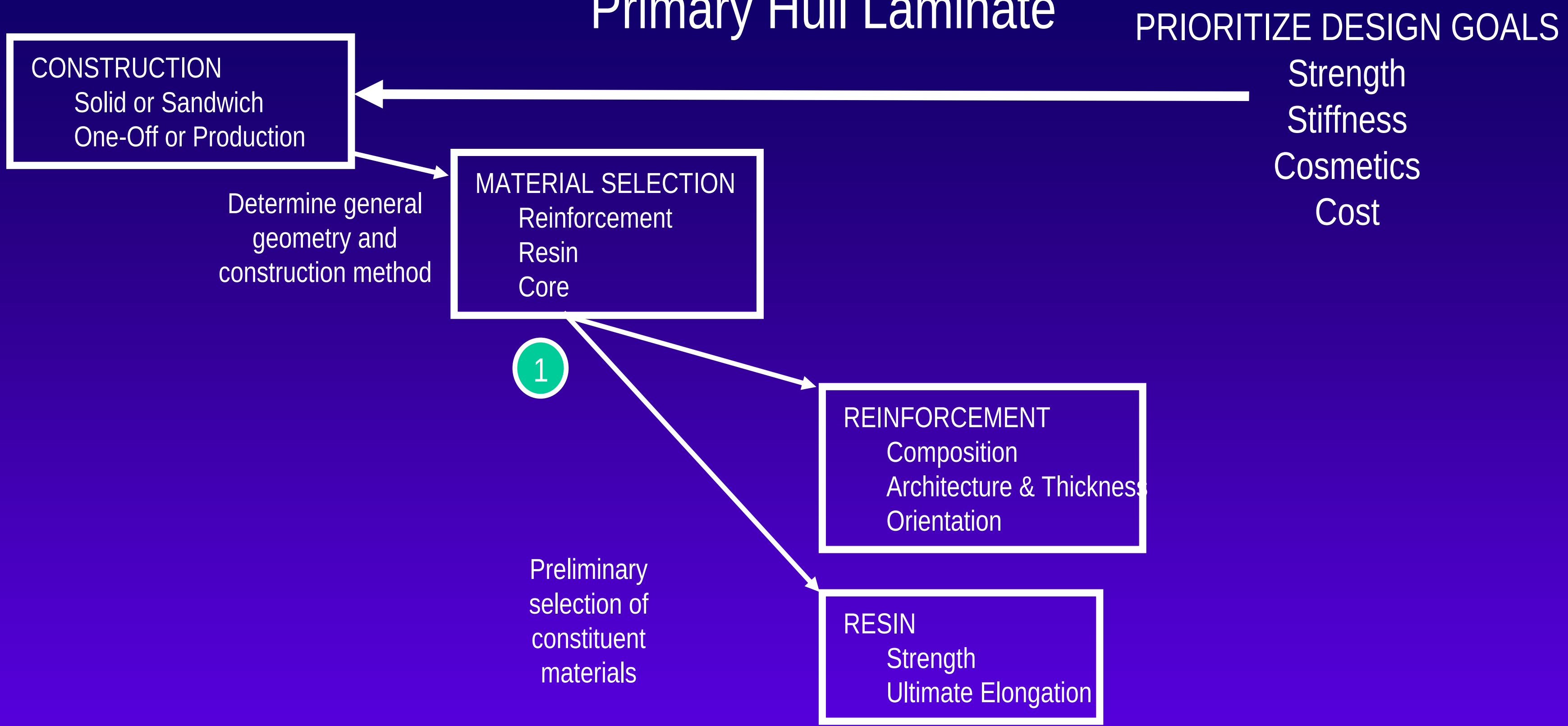
Fiber Composition

Fiber	Density lb/in^3	Tensile Strength psi x 10^3	Tensile Modulus psi x 10^6	Ultimate Elongation	Cost $/lb
E-Glass	.094	500	10.5	4.8%	.80-1.20
S-Glass	.090	665	12.6	5.7%	4
Aramid-Kevlar® 49	.052	525	18.0	2.9%	16
Spectra® 900	.035	375	17.0	3.5%	22
Polyester-COMPET®	.049	150	1.4	22.0%	1.75
Carbon-PAN	.062-.065	350-700	33-57	0.38-2.0%	17-450

Fiber Architecture



Primary Hull Laminate



Primary Hull Laminate

Comparative Data for Some Thermoset Resin Systems (castings)

Resin	Barcol Hardness	Tensile Strength psi x 10^3	Tensile Modulus psi x 10^5	Ultimate Elongation	1990 Bulk Cost $/lb
Orthophthalic Atlas P 2020	42	7.0	5.9	.91%	.66
Dicyclopentadiene (DCPD) Atlas 80-6044	54	11.2	9.1	.86%	.67
Isophthalic CoRezyn 9595	46	10.3	5.65	2.0%	.85
Vinyl Ester Derakane 411-45	35	11-12	4.9	5-6%	1.44
Epoxy Gouegon Pro Set 125/226	86D*	7.96	5.3	7.7%	4.39

*Hardness values for epoxies are traditionally given on the "Shore D" scale +

Primary Hull Laminate

PRIORITIZE DESIGN GOALS
Strength
Stiffness
Cosmetics
Cost

CONSTRUCTION
Solid or Sandwich
One-Off or Production

Determine general geometry and construction method

MATERIAL SELECTION
Reinforcement
Resin
Core

1

Preliminary selection of constituent materials

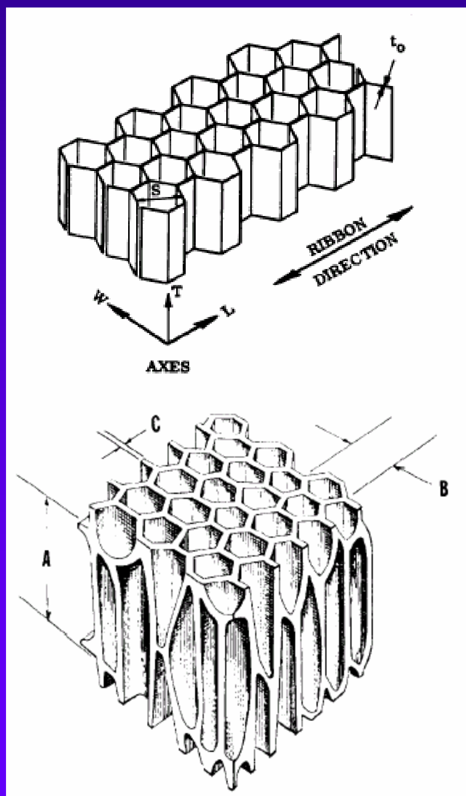
REINFORCEMENT
Composition
Architecture & Thickness
Orientation

RESIN
Strength
Ultimate Elongation

CORE
Material
Density
Thickness

Primary Hull Laminate

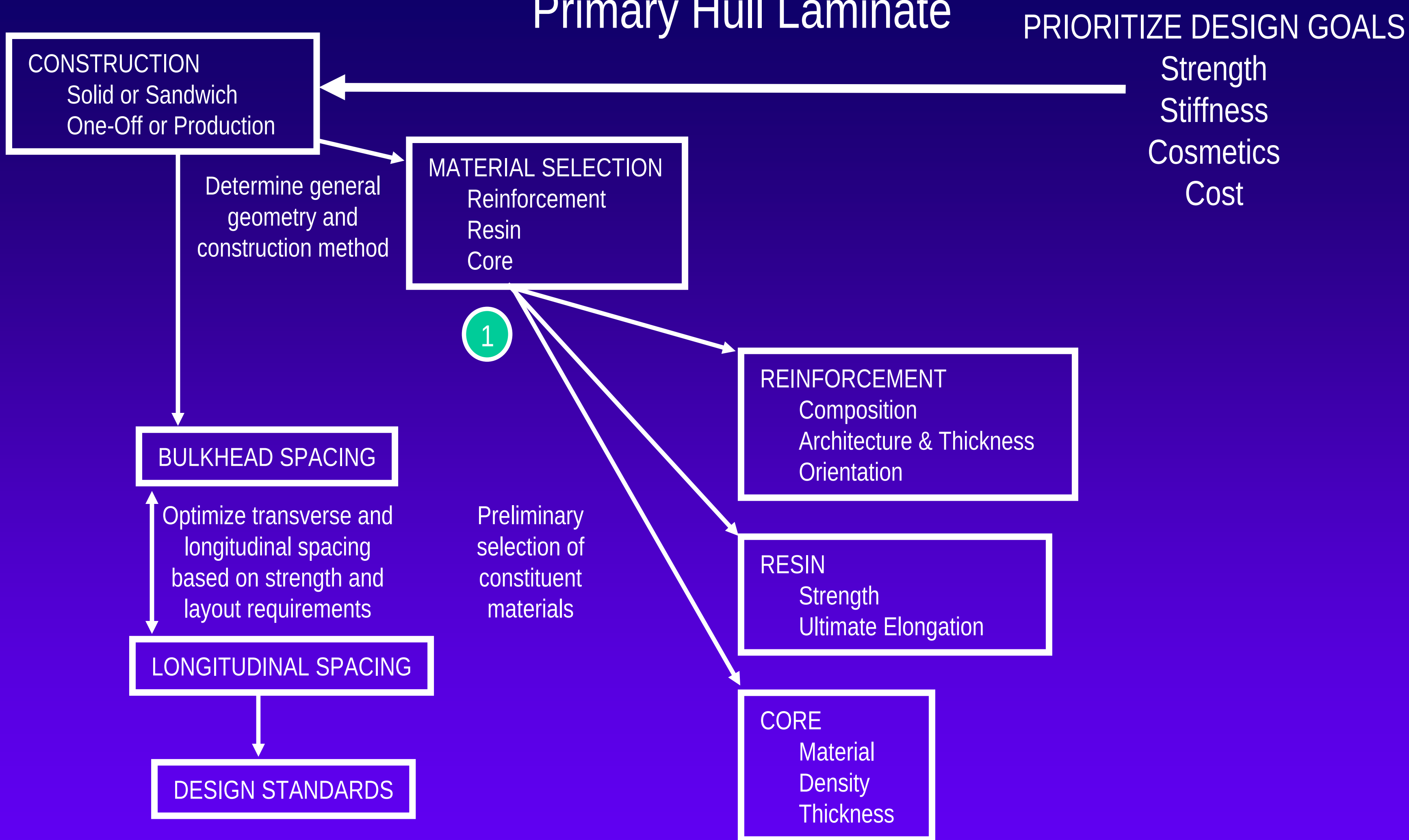
Architecture of Honeycomb and Balsa Cores



Comparative Data for Some Sandwich Core Materials

Core Material		Density		Tensile Strength		Compressive Strength		Shear Strength		Shear Modulus	
		lbs/ft^3	g/cm^3	psi	Mpa	psi	Mpa	psi	Mpa	psi x 10^3	Mpa
End Grain Balsa		7	112	1320	9.12	1190	8.19	314	2.17	17.4	120
		9	145	1790	12.3	1720	11.9	418	2.81	21.8	151
Cross-Linked PVC Foam	Termanto, C70.75	4.7	75	320	2.21	204	1.41	161	1.11	1.61	11
	Klegecell II	4.7	75	175	1.21	160	1.10			1.64	11
	Divinycell H-80	5.0	80	260	1.79	170	1.17	145	1.00	4.35	30
	Termanto C70.90	5.7	91	320	2.21	258	1.78	168	1.16	2.01	13
	Divinycell H-100	6.0	96	360	2.48	260	1.79	217	1.50	6.52	45
Linear Structural Foam	Core-Cell	3-4	55	118	0.81	58	0.40	81	0.56	1.81	12
		5-5.5	80	201	1.39	115	0.79	142	0.98	2.83	20
		8-9	210	329	2.27	210	1.45	253	1.75	5.10	35
Airex Linear PVC Foam		5-6	80-96	200	1.38	125	0.86	170	1.17	2.9	29
PMI Foam	Rohacell 71	4.7	75	398	2.74	213	1.47	185	1.28	4.3	30
	Rohacell 100	6.9	111	493	3.40	427	2.94	341	2.35	7.1	49
Phenolic Resin Honeycomb		6	96	n/a	n/a	1125	7.76	200	1.38	6.0	41
Polypropylene Honeycomb		4.8	77	n/a	n/a	218	1.50	160	1.10	n/a	n/a

Primary Hull Laminate



Primary Hull Laminate

Bulkhead & Longitudinal Spacing Based on Arrangement

Bulkhead & Longitudinal Spacing Based on Design Standards

7.1.2 Single-Skin Laminates

a ***Displacement Vessels*** The thickness of the bottom shell plating in displacement vessels is to be not less than obtained from the following equation.

$$t = 0.0510s\sqrt[3]{kh}\ \text{mm} \qquad t = 0.0343s\sqrt[3]{kh}\ \text{in.}$$

t = thickness in mm or in.
s = span of shorter side of plating panel in mm or in.
k = coefficient that varies with bottom shell plating panel aspect ratio as shown in Table 7.1
h = distance in meters or feet from lower edge of plating to the freeboard deck at side

7.2.5 Frames

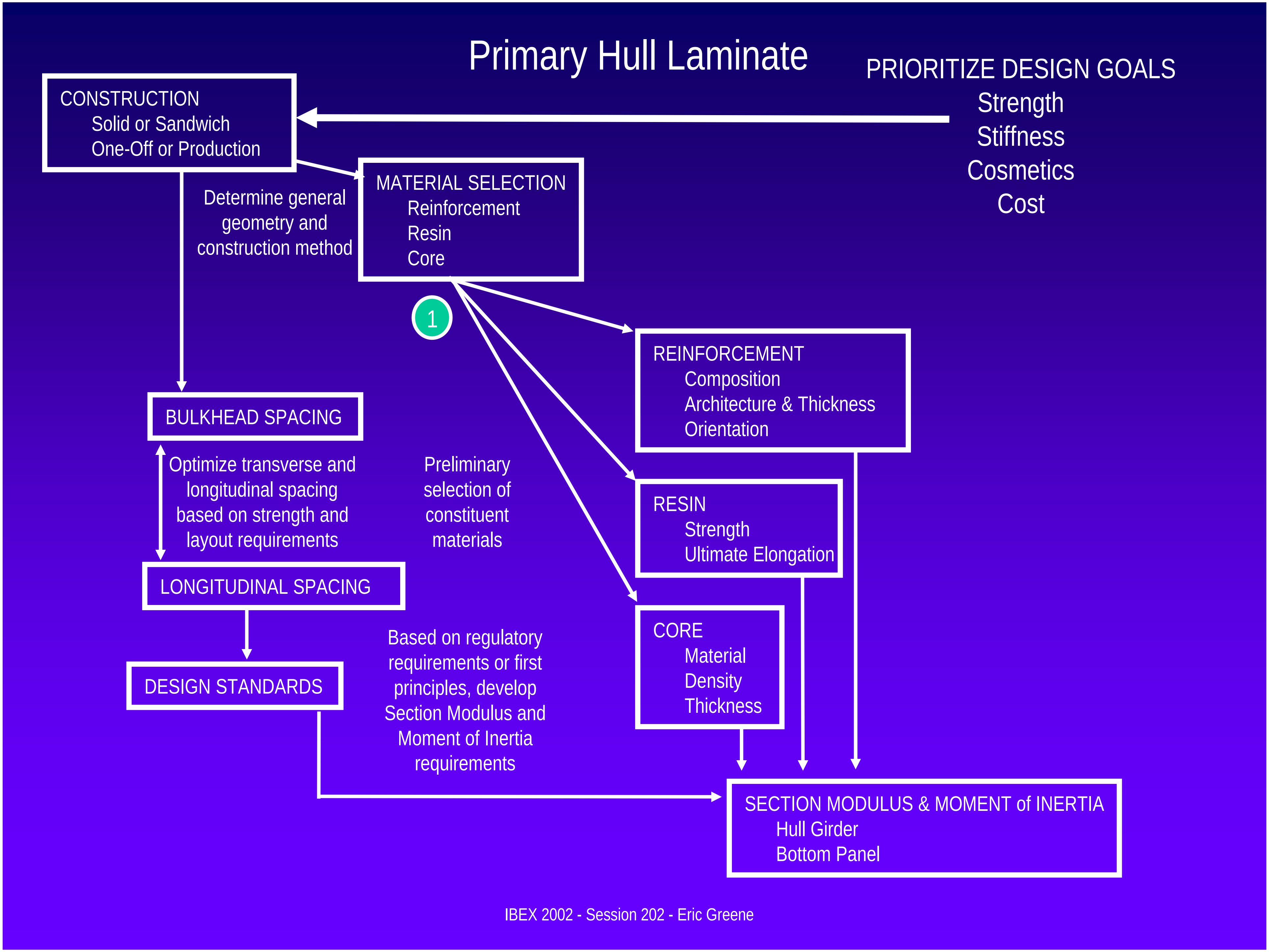
a ***Displacement Vessels*** In a displacement vessel the section modulus SM and moment of inertia I of each FRP bottom frame, where fitted, to the chine or upper turn of bilge, in association with the plating to which the frame is attached, are to be not less than obtained from the following equations.

$$SM = 19.38chsl^2\ \text{cm}^3 \qquad SM = 0.0102chsl^2\ \text{in.}^3$$

$$I = 34.85chsl^3\ \text{cm}^4 \qquad I = 0.0022chsl^3\ \text{in.}^4$$

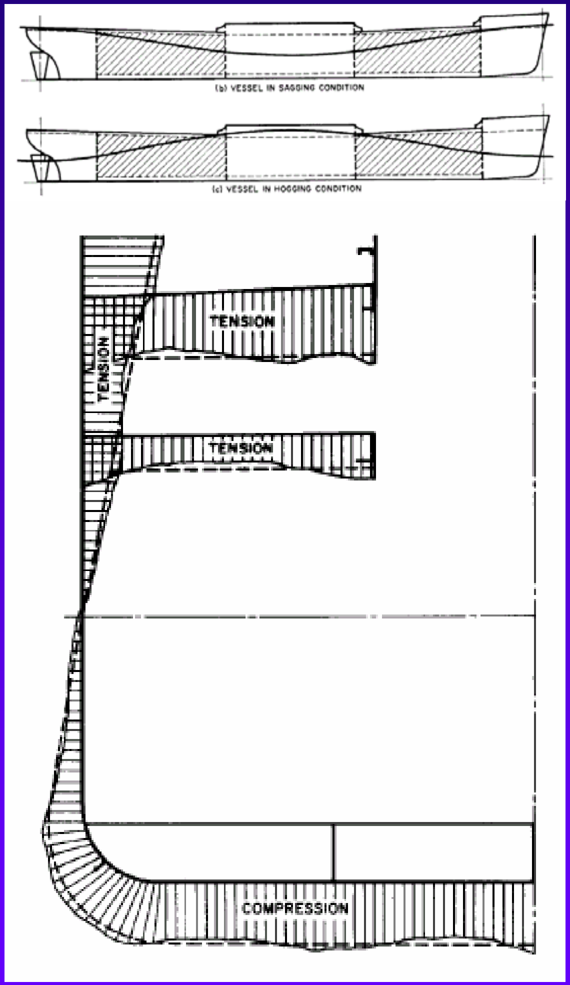
c = 0.85 for transverse frames
= 1.08 for longitudinal frames
l = unsupported span in m or ft
h = vertical distance in m or ft from the middle of l to the freeboard deck at side. In way of a deep tank, h is to be not less than required by Section 9.
s = frame spacing in m or ft

from ABS 1978 rules for Reinforced Plastic Vessels

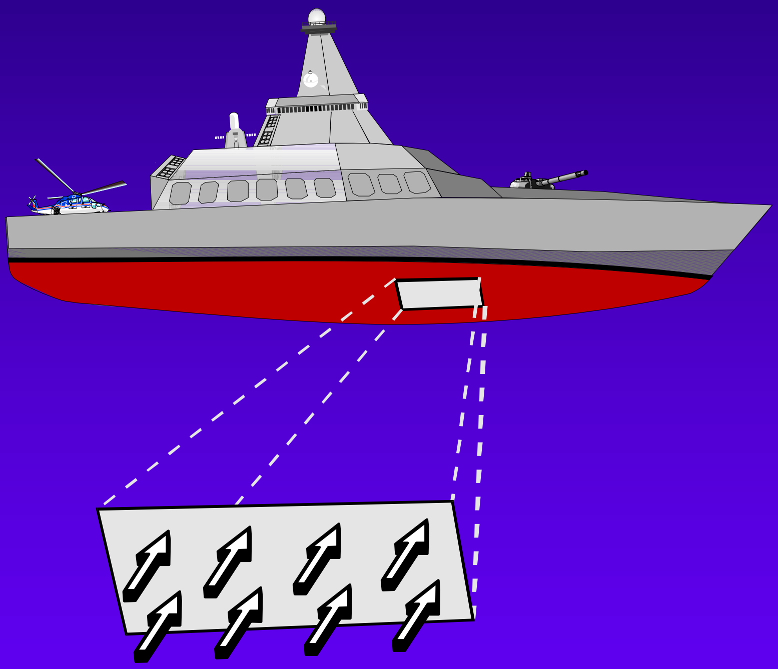

Primary Hull Laminate
PRIORITIZE DESIGN GOALS
Strength
Stiffness
Cosmetics
Cost
CONSTRUCTION
Solid or Sandwich
One-Off or Production
Determine general geometry and construction method
MATERIAL SELECTION
Reinforcement
Resin
Core
1
REINFORCEMENT
Composition
Architecture & Thickness
Orientation
BULKHEAD SPACING
Optimize transverse and longitudinal spacing based on strength and layout requirements
Preliminary selection of constituent materials
RESIN
Strength
Ultimate Elongation
LONGITUDINAL SPACING
CORE
Material
Density
Thickness
DESIGN STANDARDS
Based on regulatory requirements or first principles, develop Section Modulus and Moment of Inertia requirements
SECTION MODULUS & MOMENT of INERTIA
Hull Girder
Bottom Panel
IBEX 2002 - Session 202 - Eric Greene

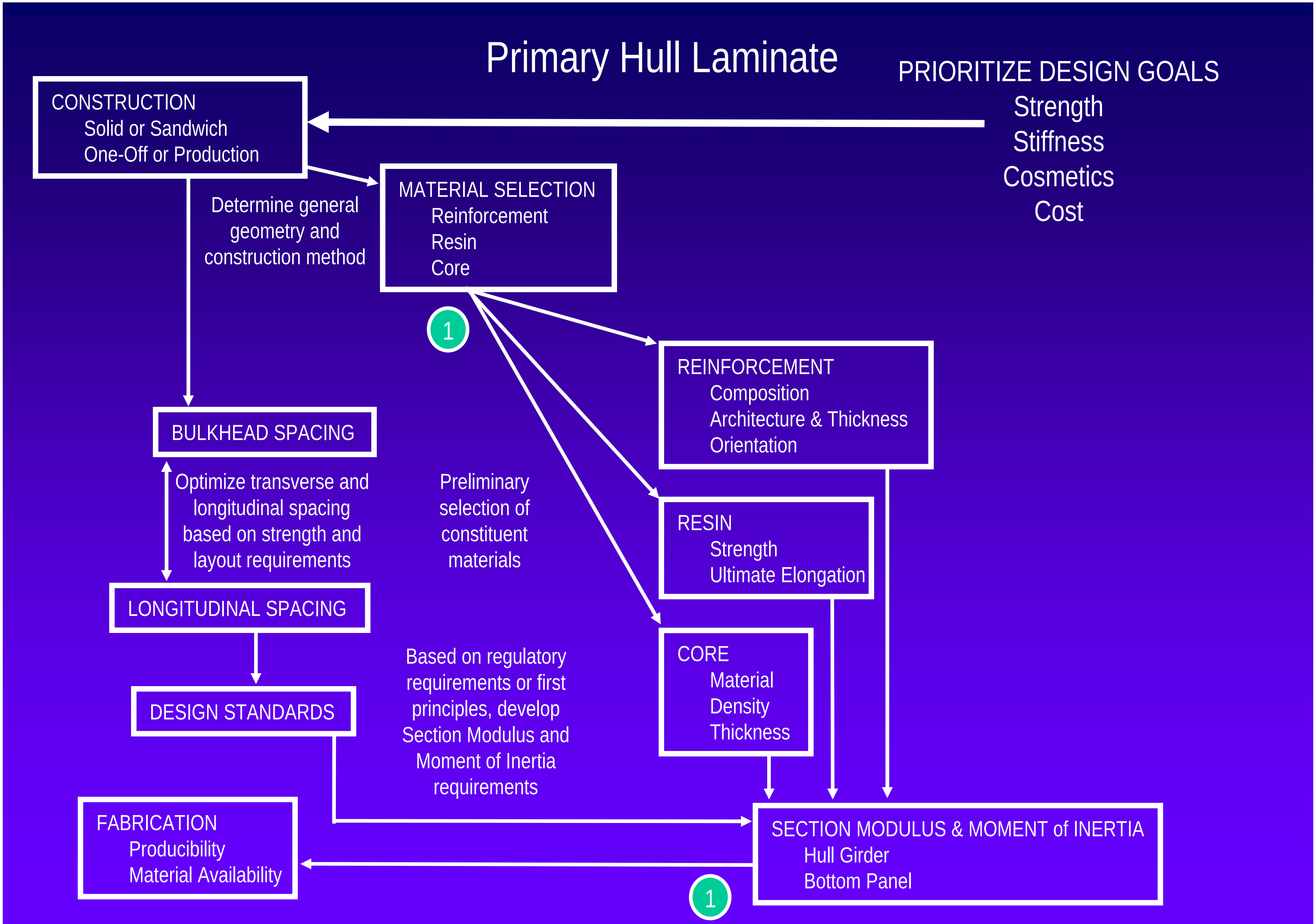
Primary Hull Laminate

Hull Girder Loads



Bottom Panel Loads




Primary Hull Laminate
PRIORITIZE DESIGN GOALS
Strength
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Cost
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Reinforcement
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Core
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Strength
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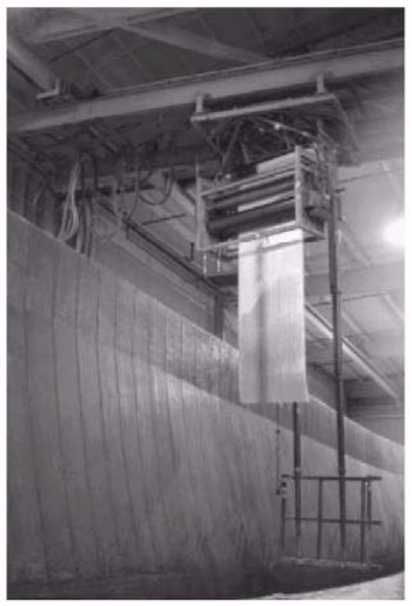
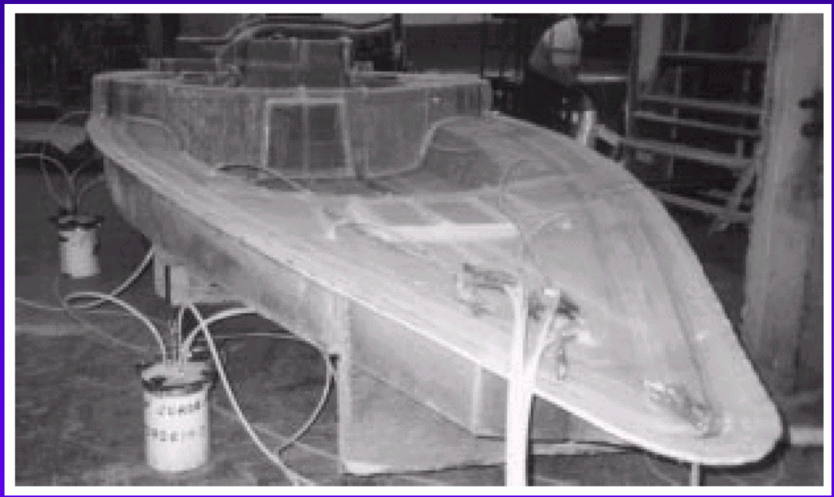
Based on regulatory requirements or first principles, develop Section Modulus and Moment of Inertia requirements
CORE
Material
Density
Thickness
DESIGN STANDARDS
FABRICATION
Producibility
Material Availability
SECTION MODULUS & MOMENT of INERTIA
Hull Girder
Bottom Panel
1

Primary Hull Laminate

Fabrication Considerations



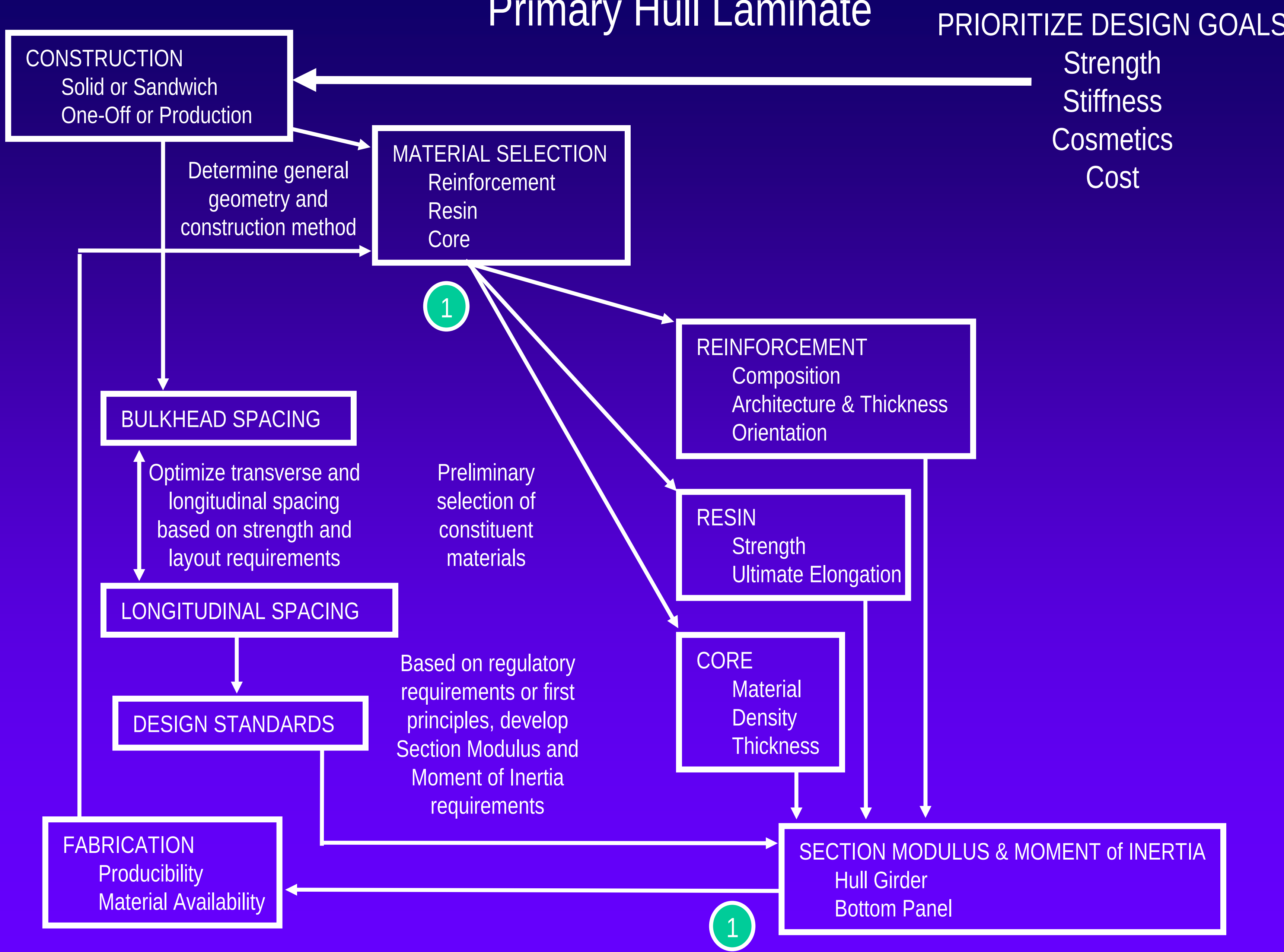
Impregnator at
Westport Shipyard



SCRIMP Infusion of Alerion 28 at TPI

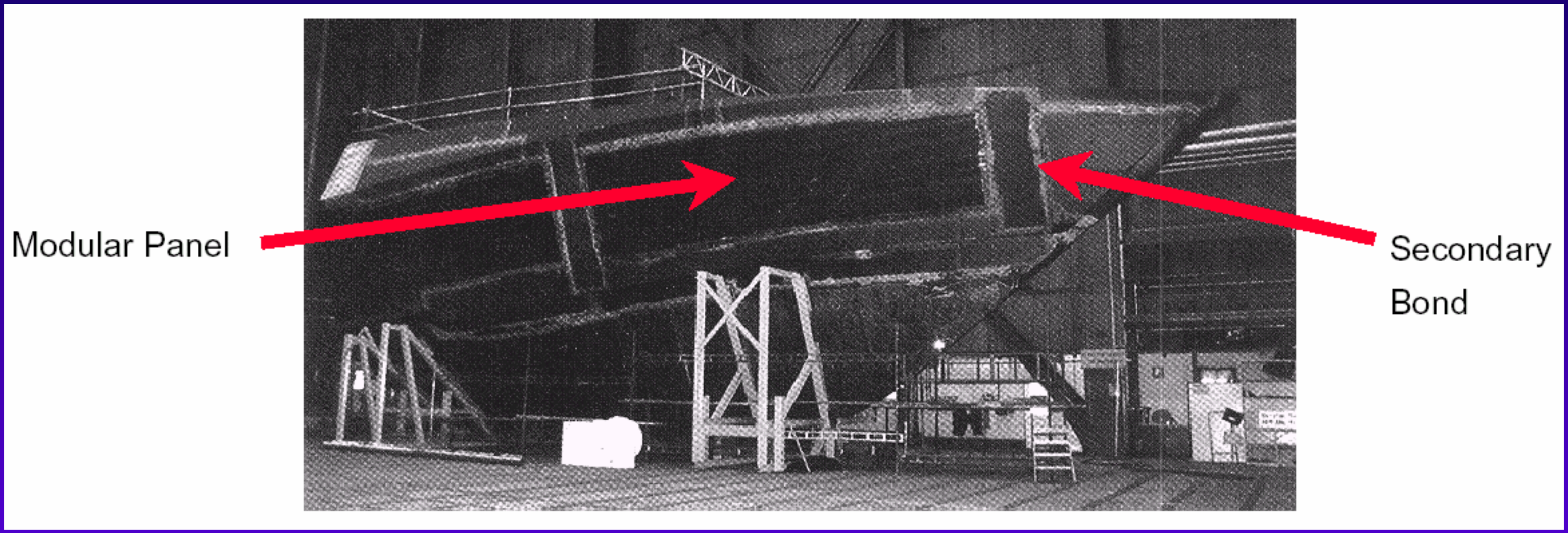
Preprep Handling at Ron Jones Marine

Primary Hull Laminate



Primary Hull Laminate

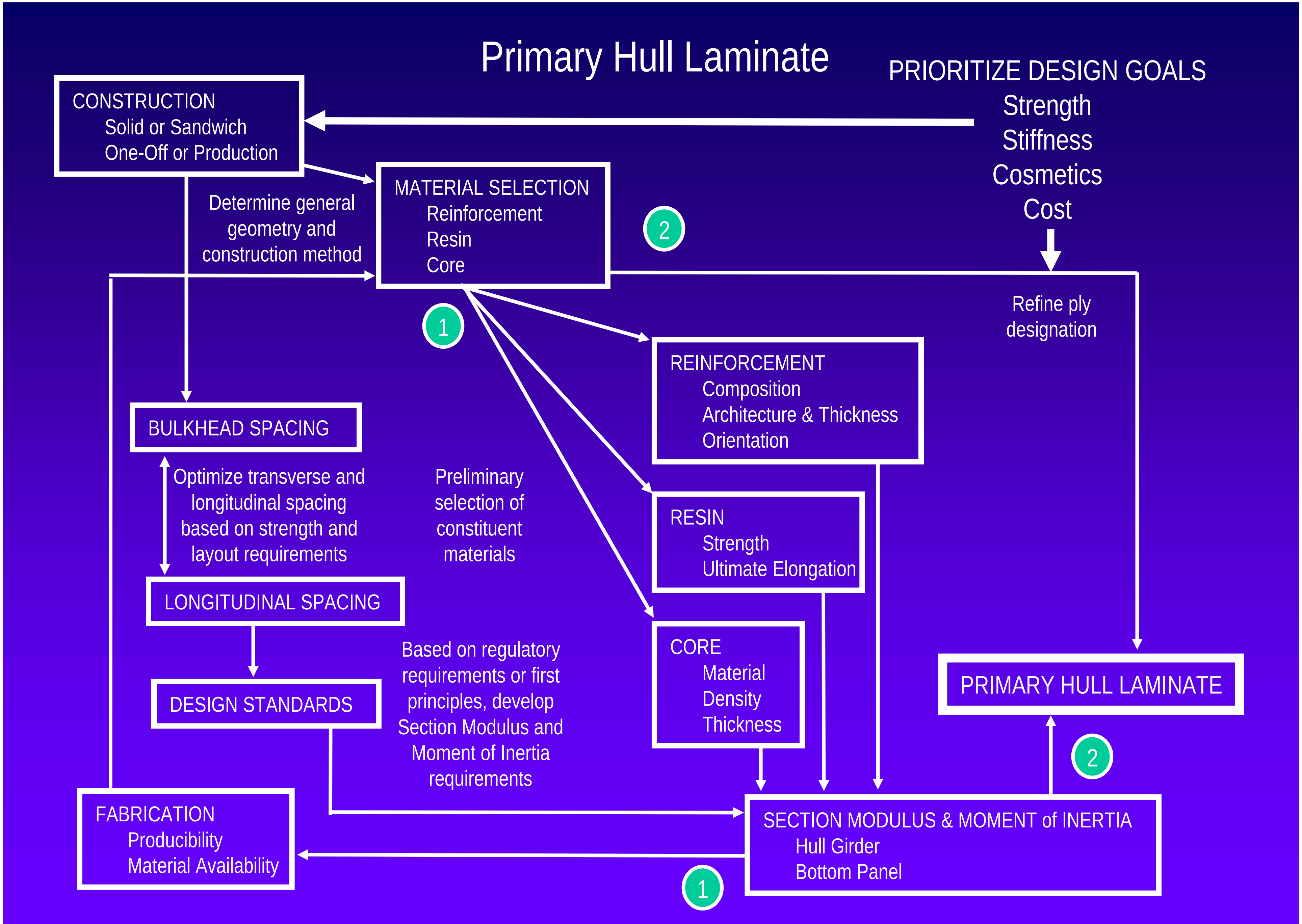
Determine General Structural Geometry and Construction Method



VISBY Class Corvette Under Construction at Kockums Karlskronavarvet in Sweden

Panel Being SCRIMPed at Avondale Gulfport Facility

LPD 17 AEM/S Under Construction at Avondale


Primary Hull Laminate
PRIORITIZE DESIGN GOALS
Strength
Stiffness
Cosmetics
Cost
CONSTRUCTION
Solid or Sandwich
One-Off or Production
Determine general geometry and construction method
MATERIAL SELECTION
Reinforcement
Resin
Core
2
1
Refine ply designation
REINFORCEMENT
Composition
Architecture & Thickness
Orientation
BULKHEAD SPACING
Optimize transverse and longitudinal spacing based on strength and layout requirements
Preliminary selection of constituent materials
RESIN
Strength
Ultimate Elongation
LONGITUDINAL SPACING
Based on regulatory requirements or first principles, develop Section Modulus and Moment of Inertia requirements
CORE
Material
Density
Thickness
PRIMARY HULL LAMINATE
DESIGN STANDARDS
2
FABRICATION
Producibility
Material Availability
SECTION MODULUS & MOMENT of INERTIA
Hull Girder
Bottom Panel
1

Primary Hull Laminate

Refine Primary Hull Laminate and Stringers

Midship Section of 1/2 Scale Corvette Built by Seemann Composites for NSWCCD

Bottom Panels Subject to Slamming

Consider life-cycle
requirements of the vessel
to determine expected
wave encounter in terms
of height and frequency

Bottom Panels Subject to Slamming

Determine In-Service Profile

USCG 47-foot Motor Lifeboat

Larson 98 Model 226 LXI Advertised For Sale: “used very little”

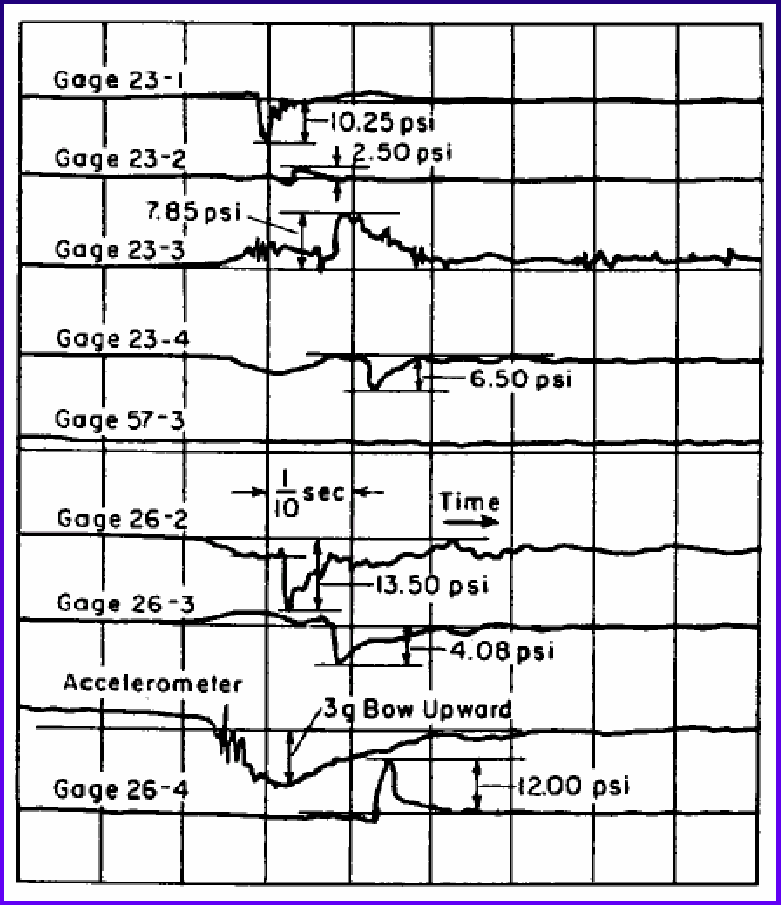
Bottom Panels Subject to Slamming

DEVELOP DESIGN PRESSURE
- Hull Geometry
- Vessel Speed
- In-Service Conditions
- Design Criteria

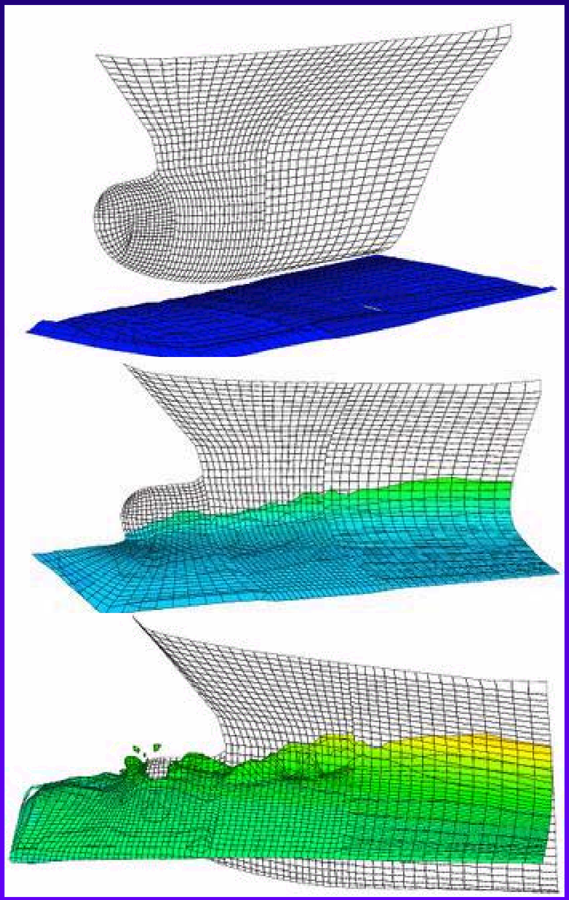
Consider life-cycle requirements of the vessel to determine expected wave encounter in terms of height and frequency

Bottom Panels Subject to Slamming

Develop Design Pressure



Pressures Recorded by Heller and Jasper
on Patrol Craft at 28 Knots



Three-Dimensional Slamming Simulation
by Germanischer Lloyd AG

Bottom Panels Subject to Slamming

Rule-Based Design Pressure

b *Planing Vessels* The thickness of the bottom shell plating in planing vessels is to be not less than either required by 7.1.2a or obtained from the following equations.

1 Where speed of vessel is less than or equal to 31 knots

$$t = 0.0384s\sqrt[3]{kV} \text{ mm or in.}$$

2 Where speed of vessel is greater than 31 knots

$$t = 0.0122s\sqrt[3]{kV^2} \text{ mm or in.}$$

t = thickness in mm or in.
s = span of shorter side of plating panel in mm or in.
k = coefficient that varies with bottom shell plating panel aspect ratio as shown in Table 7.1
V = sea speed of vessel in knots

From *ABS 1978 Rules for Reinforced Plastic Vessels*, Section 7

Bottom Panels Subject to Slamming

CONSTRUCTION
- Solid or Sandwich
- One-Off or Production

DEVELOP DESIGN PRESSURE
- Hull Geometry
- Vessel Speed
- In-Service Conditions
- Design Criteria

Consider life-cycle requirements of the vessel to determine expected wave encounter in terms of height and frequency

Bottom Panels Subject to Slamming

Construction Method

Prepreg/Nomex Honeycomb Core Construction
of Hydroplane at Ron Jones Marine

Hand Layup of Solid Laminate Hull
at Westport Marine

Bottom Panels Subject to Slamming

CONSTRUCTION
- Solid or Sandwich
- One-Off or Production

INITIAL MATERIAL SELECTION
- Reinforcement
- Resin
- Core

Consider life-cycle requirements of the vessel to determine expected wave encounter in terms of height and frequency

DEVELOP DESIGN PRESSURE
- Hull Geometry
- Vessel Speed
- In-Service Conditions
- Design Criteria

Bottom Panels Subject to Slamming

Initial Material Selection

Reinforcements

Parameter	E-Glass	Carbon	Kevlar®
Workability	Good	Fair	Fair
Cost	Excellent	Poor	Fair
Static Strength	Good	Excellent	Good
Dynamic Strength	Good	Good	Excellent
Elevated Temperature Performance	Good	Good	Fair

Resins

Parameter	Polyester	Vinyl ester	Epoxy
Workability	Excellent	Excellent	Good
Cost	Excellent	Good	Fair
Static Strength	Fair	Good	Excellent
Dynamic Strength	Fair	Good	Good
Elevated Temperature Performance	Fair	Good	Good

Cores

Parameter	Balsa	PVC Foam
Workability	Good	Good
Cost	Excellent	Good
Static Strength	Good	Fair
Dynamic Strength	Fair	Good
Elevated Temperature Performance	Good	Poor

Bottom Panels Subject to Slamming

DEVELOP DESIGN PRESSURE
- Hull Geometry
- Vessel Speed
- In-Service Conditions
- Design Criteria

Consider life-cycle requirements of the vessel to determine expected wave encounter in terms of height and frequency

CONSTRUCTION
- Solid or Sandwich
- One-Off or Production

INITIAL MATERIAL SELECTION
- Reinforcement
- Resin
- Core

BULKHEAD SPACING

Optimize transverse and longitudinal spacing based on strength and layout requirements

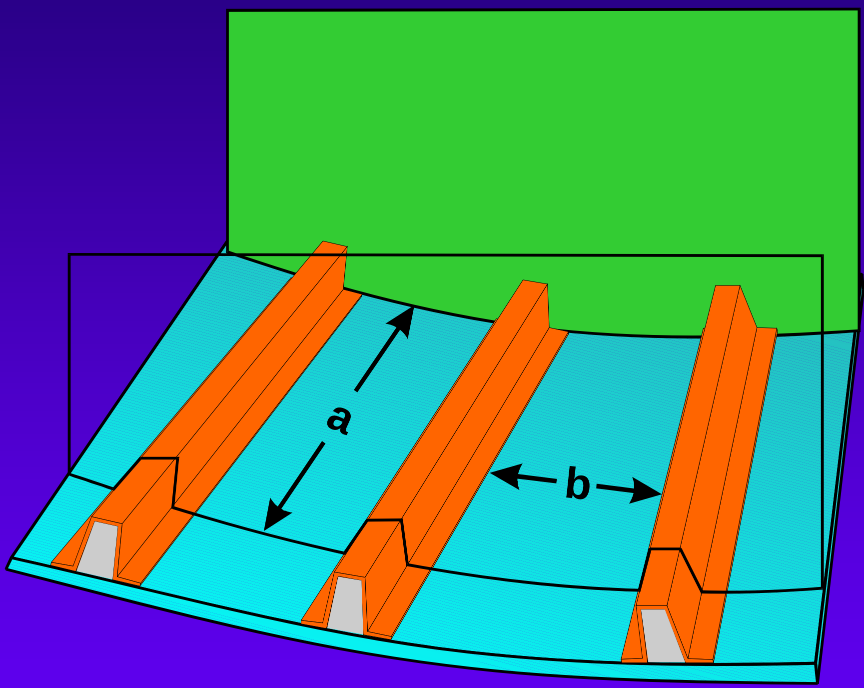
LONGITUDINAL SPACING

DETERMINE PANEL SIZE
- Aspect Ratios
- Dimensions

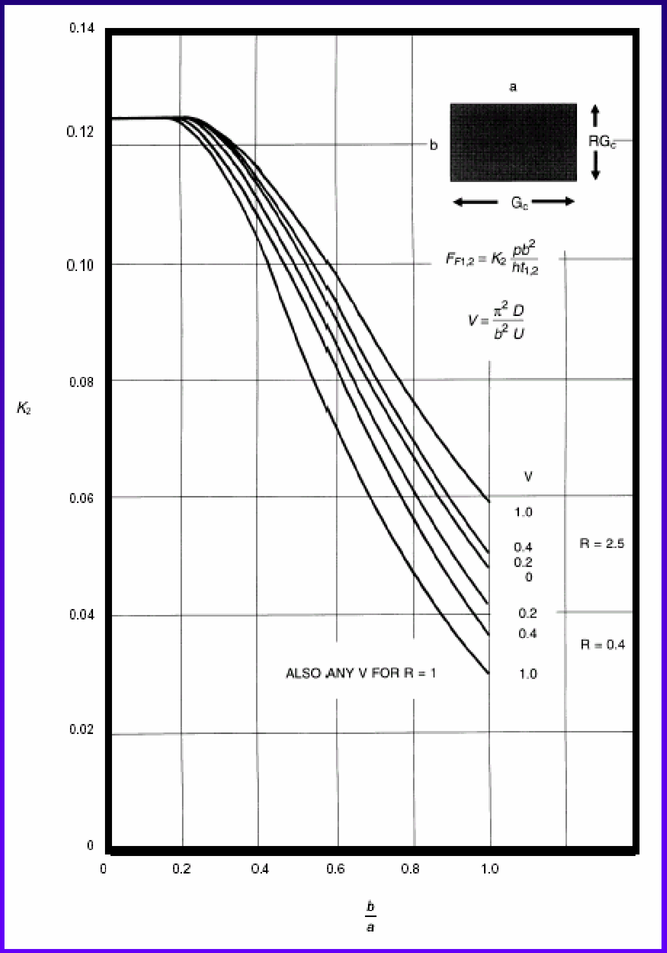
Consider end conditions of panel at bulkhead and stiffener attachment points

Bottom Panels Subject to Slamming

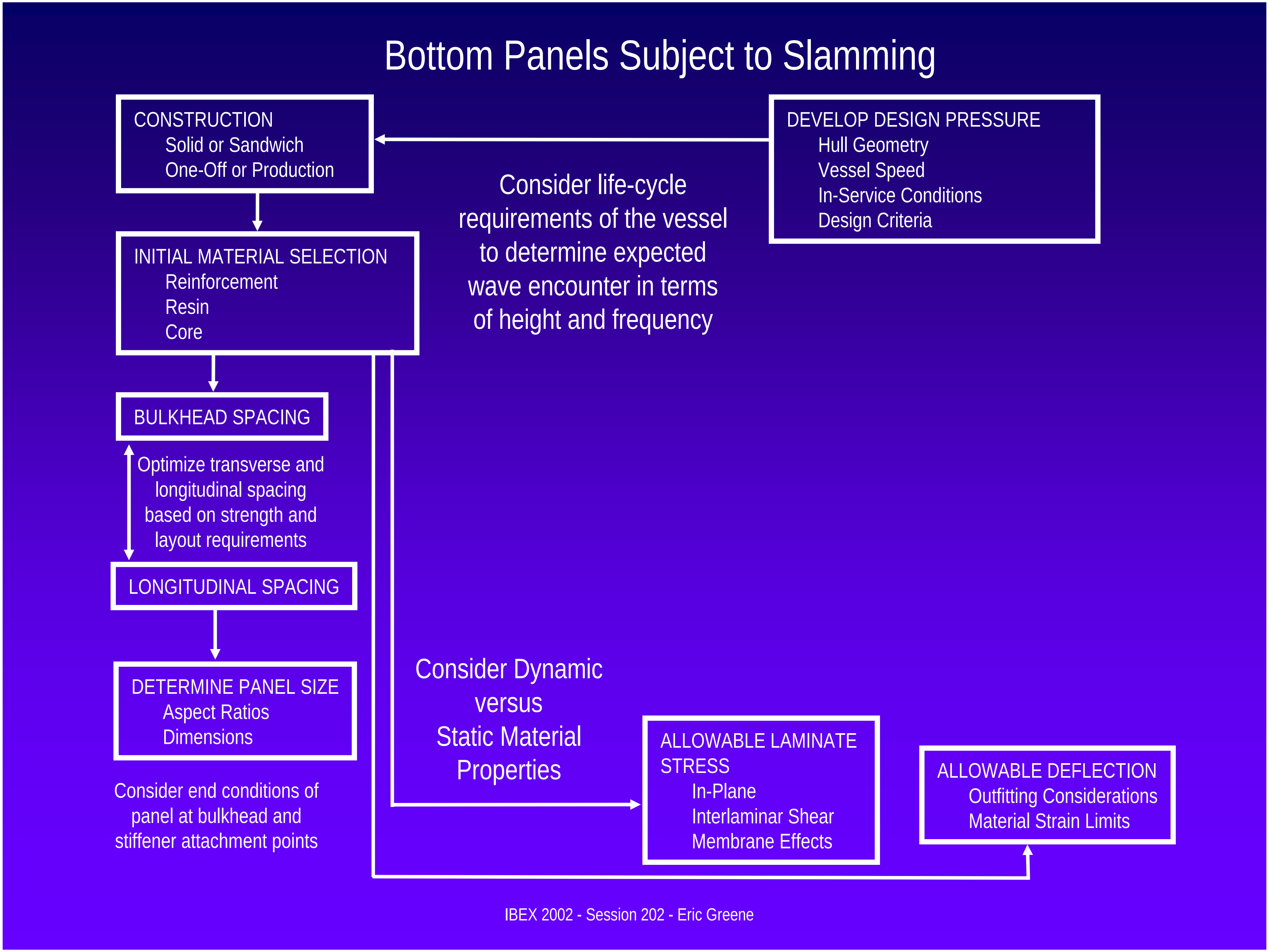
Determine Panel Size



Bottom Panel Geometry Showing
Aspect Ratio and End Conditions



Stress Coefficient as a Function of Panel
Aspect Ratio from MARINE COMPOSITES



Bottom Panels Subject to Slamming
CONSTRUCTION
Solid or Sandwich
One-Off or Production
DEVELOP DESIGN PRESSURE
Hull Geometry
Vessel Speed
In-Service Conditions
Design Criteria
Consider life-cycle requirements of the vessel to determine expected wave encounter in terms of height and frequency
INITIAL MATERIAL SELECTION
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BULKHEAD SPACING
Optimize transverse and longitudinal spacing based on strength and layout requirements
LONGITUDINAL SPACING
DETERMINE PANEL SIZE
Aspect Ratios
Dimensions
Consider end conditions of panel at bulkhead and stiffener attachment points
Consider Dynamic versus Static Material Properties
ALLOWABLE LAMINATE STRESS
In-Plane
Interlaminar Shear
Membrane Effects
ALLOWABLE DEFLECTION
Outfitting Considerations
Material Strain Limits
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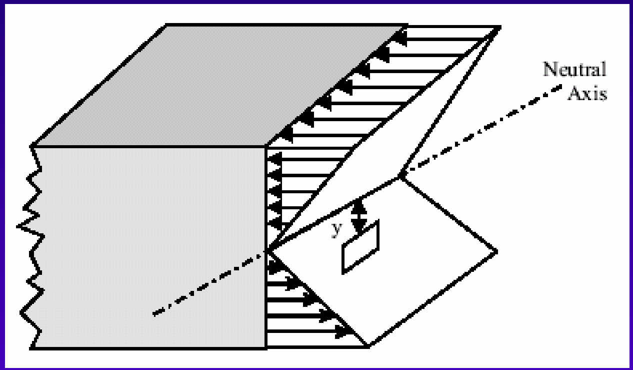
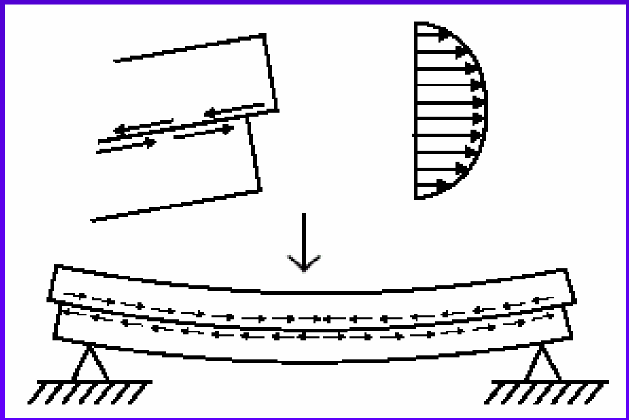
Bottom Panels Subject to Slamming

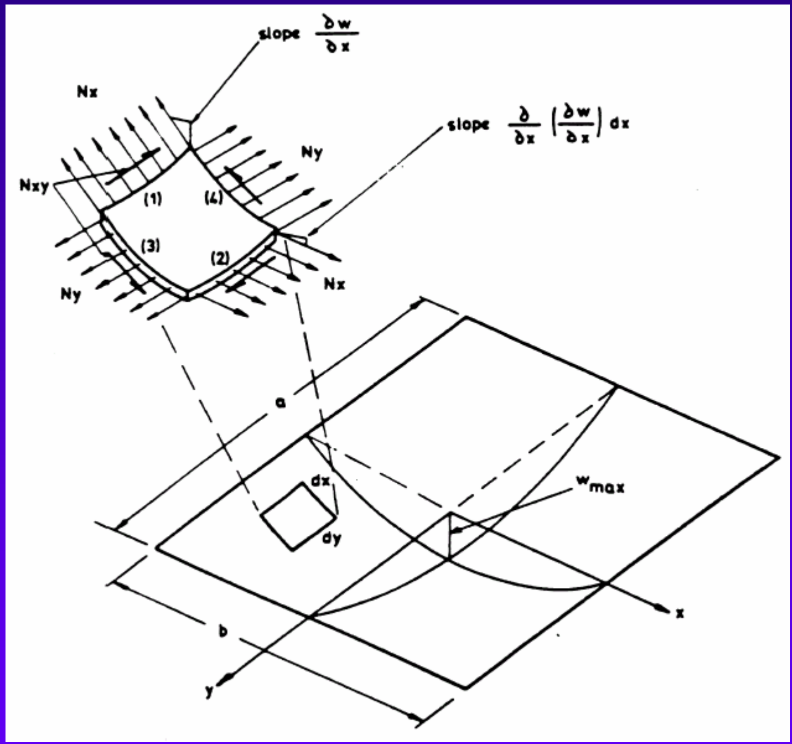
Stresses and Deflections in Panels



Maximum In-Plane Stress in Beams Subject to Bending

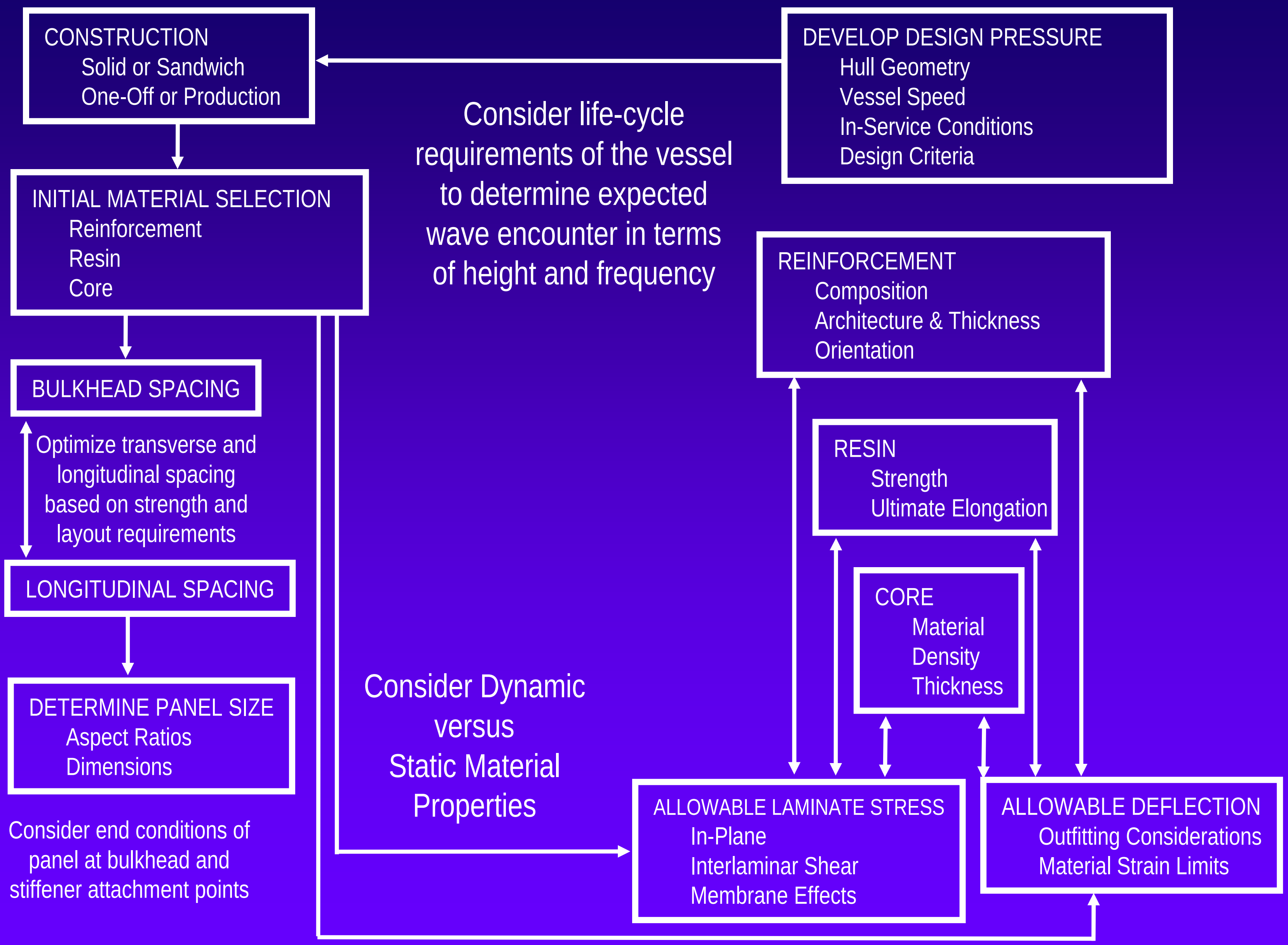


Maximum Shear Stress in Beams Subject to Bending



Stresses and Deflections due to Membrane Effects

Bottom Panels Subject to Slamming



Bottom Panels Subject to Slamming

Refine Material Selection based on Strain Limits

$$\varepsilon_{cai} = \frac{\sigma_{ai}}{E_{ai}\left[\,\left|\bar{y} - y_i\right| + \tfrac{1}{2} t_i\,\right]}$$

where:

σ_{ai} = strength of ply under consideration
= σ_t for a ply in the outer skin
= σ_c for a ply in the inner skin

E_{ai} = modulus of ply under consideration
= E_t for a ply in the outer skin
= E_c for a ply in the inner skin

$\bar{y}$ = distance from the bottom of the panel to the neutral axis

y_i = distance from the bottom of the panel to the ply under consideration

t_i = thickness of ply under consideration

σ_t = tensile strength of the ply being considered

σ_c = compressive strength of the ply being considered

E_t = tensile stiffness of the ply being considered

E_c = compressive stiffness of the ply being considered

First Ply Failure Based on First Play Critical Strain Limits from the *ABS Guide for Building and Classing High-Speed Craft*

Bottom Panels Subject to Slamming

Refine Material Selection based on Stress Limits

$$SM_o = \frac{\sum_{i=1}^{n} FM_i}{\sigma_{to}}$$

$$SM_i = \frac{\sum_{i=1}^{n} FM_i}{\sigma_{ci}}$$

where:

SM_o = section modulus of outer skin

SM_i = section modulus of inner skin

n = total number of plies in the skin laminate

σ_{to} = tensile strength of outer skin determined from mechanical testing or via calculation of tensile strength using a weighted average of individual plies for preliminary estimations

σ_{ci} = compressive strength of inner skin determined from mechanical testing or via calculation of compressive strength using a weighted average of individual plies for preliminary estimations

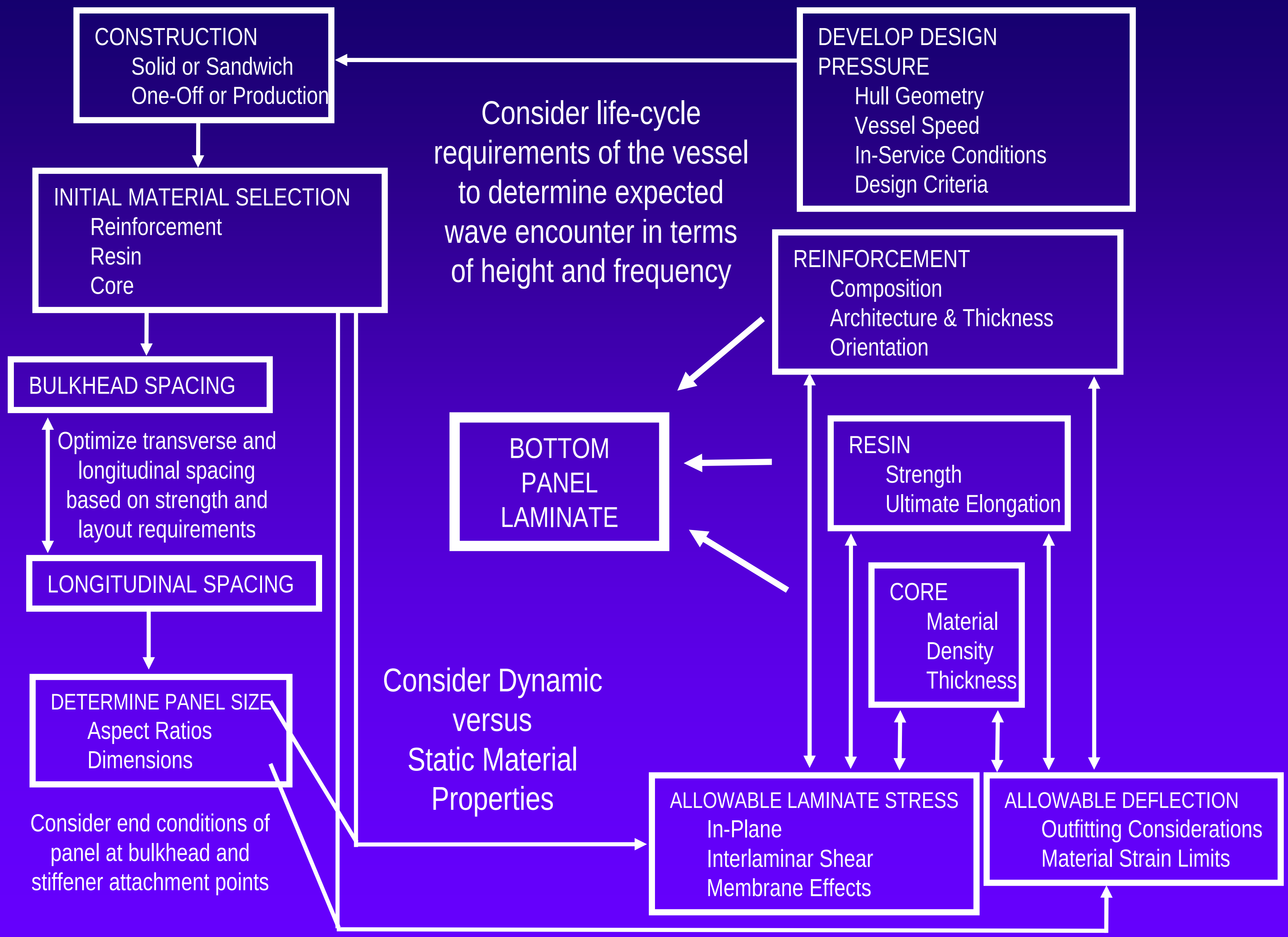
$$FM_i = \varepsilon_{min} E_{ci} t_i \left(\left|\bar{y} - y_i\right|\right)^2$$

where:

ε_{min} = the smallest critical strain that is acting on an individual ply

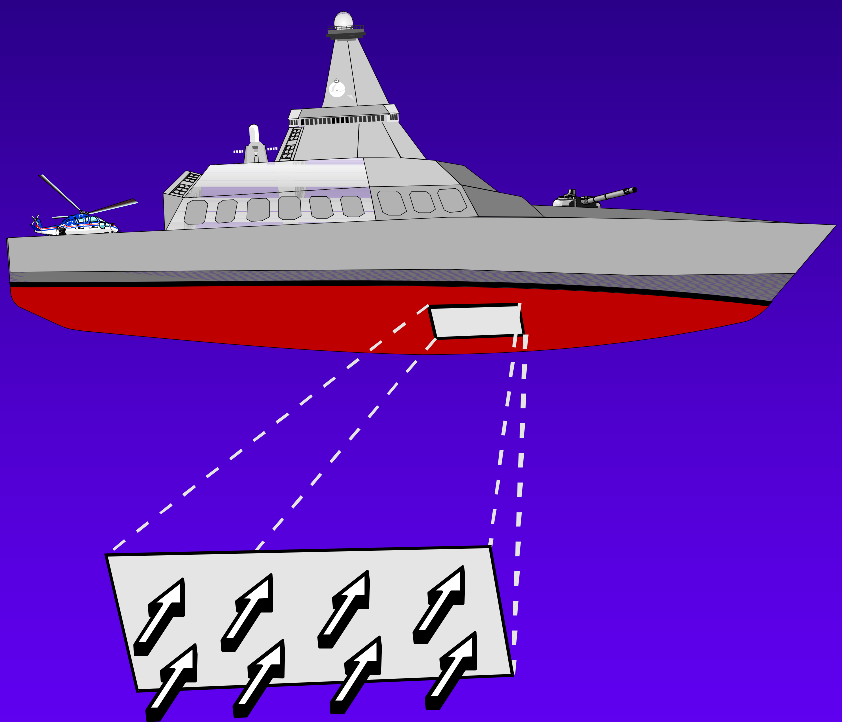
Skin Section Modulus Based on Applied Failure Moment from the *ABS Guide for Building and Classing High-Speed Craft*

Bottom Panels Subject to Slamming

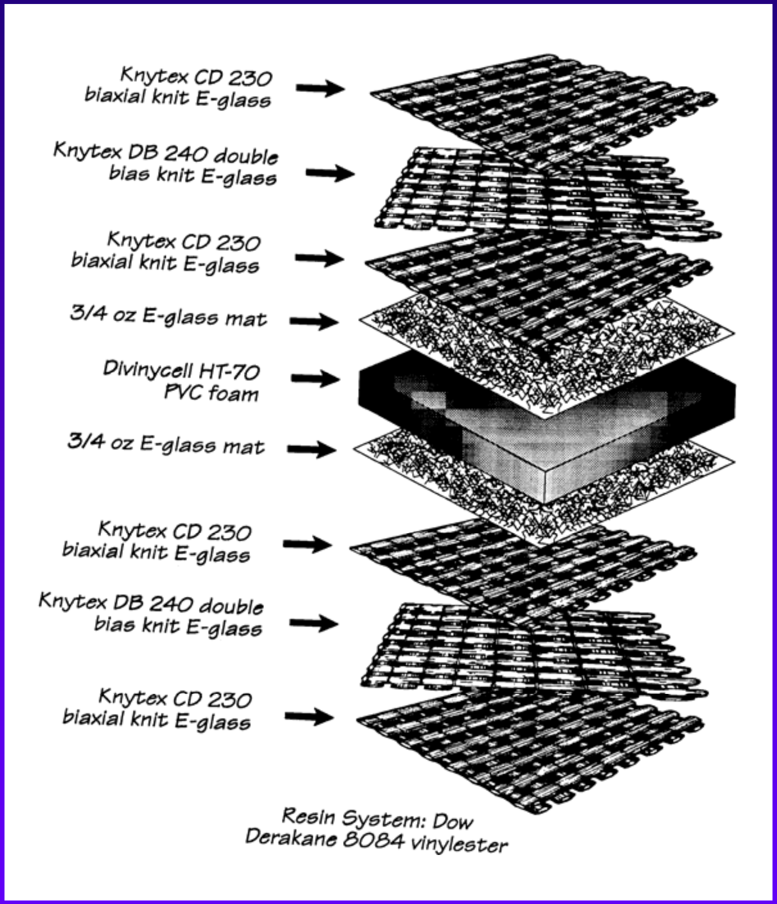


Bottom Panels Subject to Slamming

Refine Material Selection based on Stress Limits



Forces Perpendicular to Panel Surface due to Hydrostatic Pressure and Wave Slamming Loads



Typical Laminate Designation

Decks

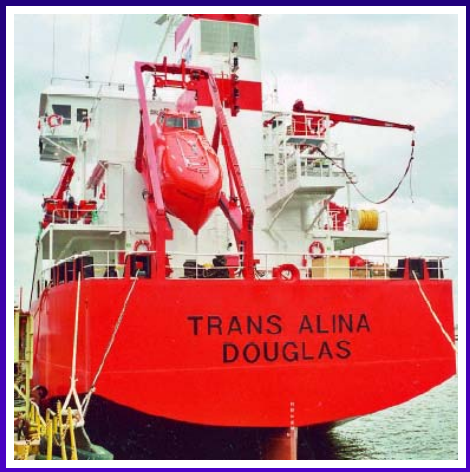
PRIORITIZE DESIGN GOALS

- Strength
- Stiffness
- Cosmetics
- Cost

Decks

Prioritize Design Goals

Strength



Norsafe Free-Fall Lifeboat

Stiffness

America's Cup Yacht STARS and STRIPES

Cosmetics

Hinckley's Picnic Boat

Cost

Sunfish Built by Vanguard Sailboats

Decks

DETERMINE PRELIMINARY ARRANGEMENT

- Deckhouse
- Cockpit

PRIORITIZE DESIGN GOALS

- Strength
- Stiffness
- Cosmetics
- Cost

Decks

Determine Preliminary Arrangement

Conceptual Deck Layout for 147-Foot Motoryacht from Espinosa Yacht Design

Deck Layout for the
Farr 56 Pilot House Yacht

Decks

DETERMINE PRELIMINARY ARRANGEMENT
- Deckhouse
- Cockpit

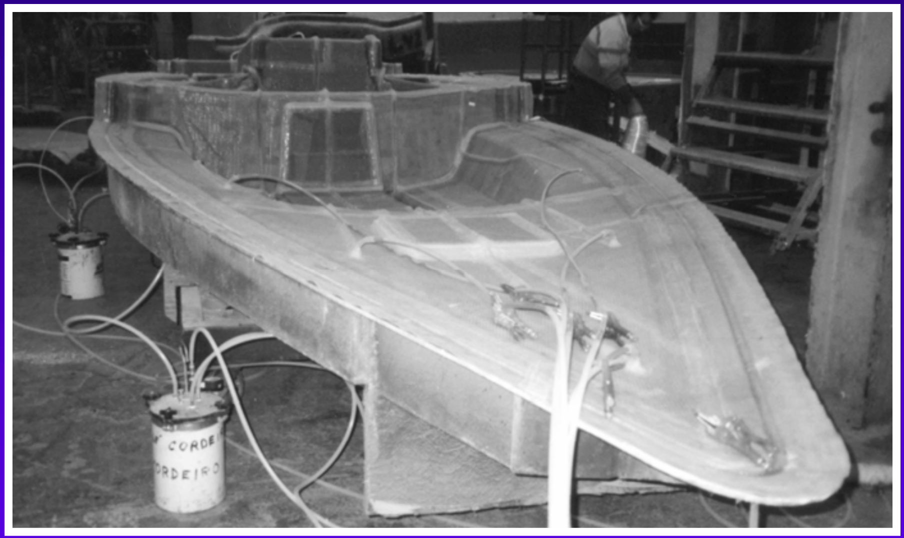
CONSTRUCTION
- Solid or Sandwich
- Male or Female Deck Mold

PRIORITIZE DESIGN GOALS
- Strength
- Stiffness
- Cosmetics
- Cost

Decks

Determine Construction Method

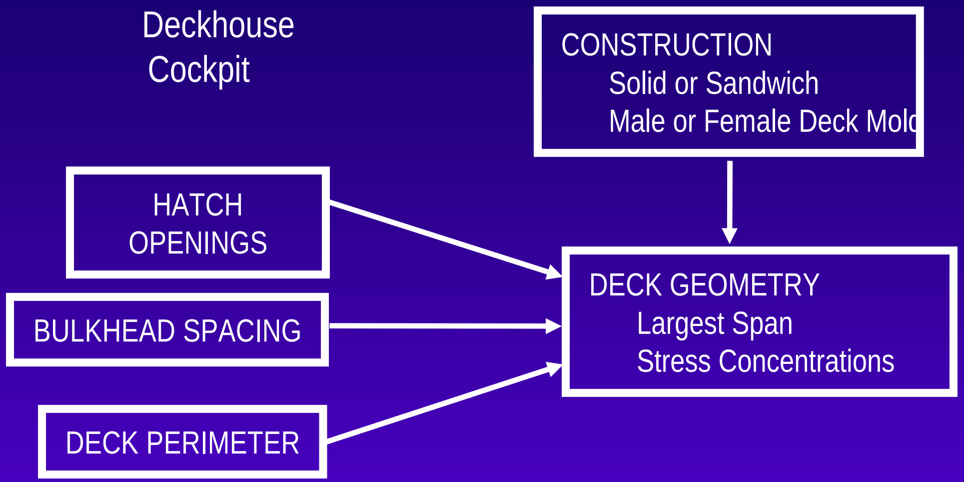
Hardware Placement Jig Lowered in Place
at Corsair Marine



Alerion 28 Deck Assembly being SCRIMPed at TPI

Decks

DETERMINE PRELIMINARY ARRANGEMENT
Deckhouse
Cockpit

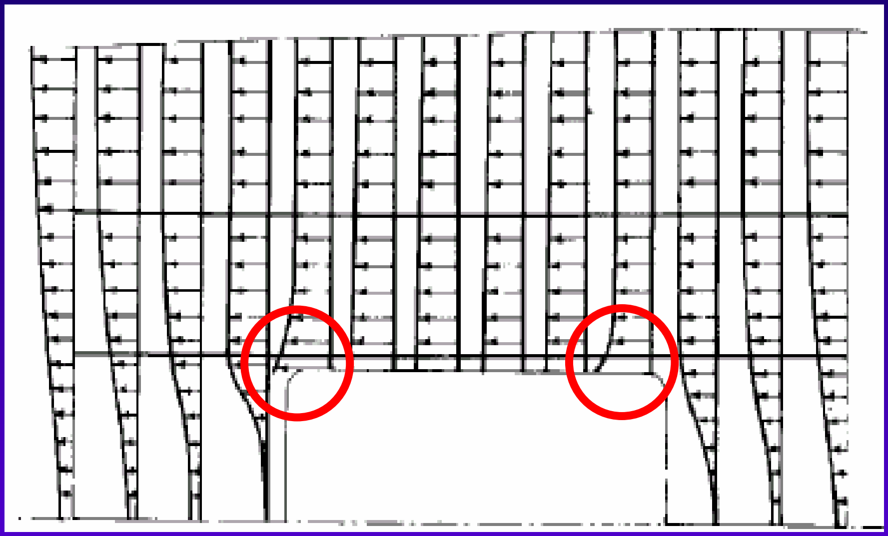


PRIORITIZE DESIGN GOALS
- Strength
- Stiffness
- Cosmetics
- Cost

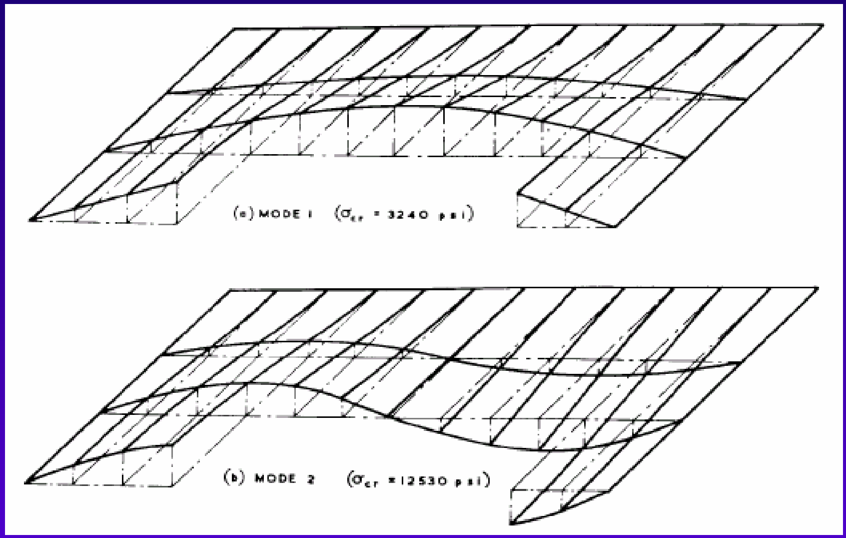
Develop deck structure drawing based on geometric considerations

Decks

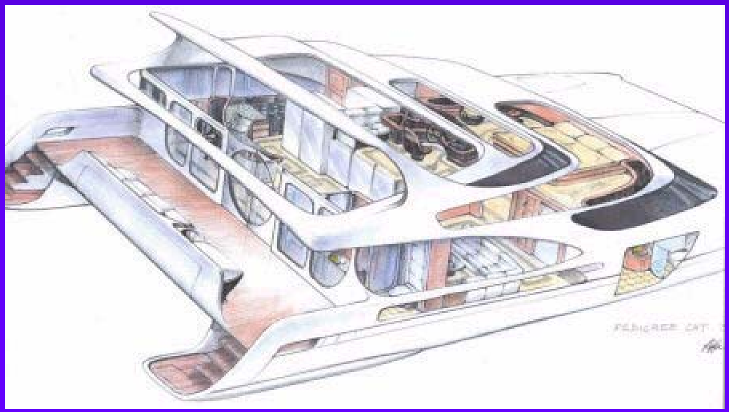
Develop Deck Geometry



Distribution of Longitudinal Stress at Hatch Opening
from C.S. Smith



Deck Buckling Mode Near Hatch Opening
from C.S. Smith



Pedigree 525 Catamaran Showing
Spacious Interior
(Styling by Phil Aylsworth)

Decks

DETERMINE PRELIMINARY ARRANGEMENT
Deckhouse
Cockpit

CONSTRUCTION
Solid or Sandwich
Male or Female Deck Mold

HATCH OPENINGS

BULKHEAD SPACING

DECK PERIMETER

DECK GEOMETRY
Largest Span
Stress Concentrations

DECK DEPTH RESTRICTIONS
Headroom Requirements
Outfitting Accommodation

PRIORITIZE DESIGN GOALS
- Strength
- Stiffness
- Cosmetics
- Cost

Develop deck structure drawing based on geometric considerations

Decks

Consider Deck Depth Restrictions

Nautica Flush-Deck Military
Version 30-Foot RIB

Illbruck Challenge
Volvo Ocean Race Yacht

Decks

DETERMINE PRELIMINARY ARRANGEMENT
Deckhouse
Cockpit

CONSTRUCTION
Solid or Sandwich
Male or Female Deck Mold

PRIORITIZE DESIGN GOALS
Strength
Stiffness
Cosmetics
Cost

HATCH OPENINGS

BULKHEAD SPACING

DECK PERIMETER

DECK GEOMETRY
Largest Span
Stress Concentrations

CREW, EQUIPMENT & CARGO LOADS
Weights & Footprints
Accelerations

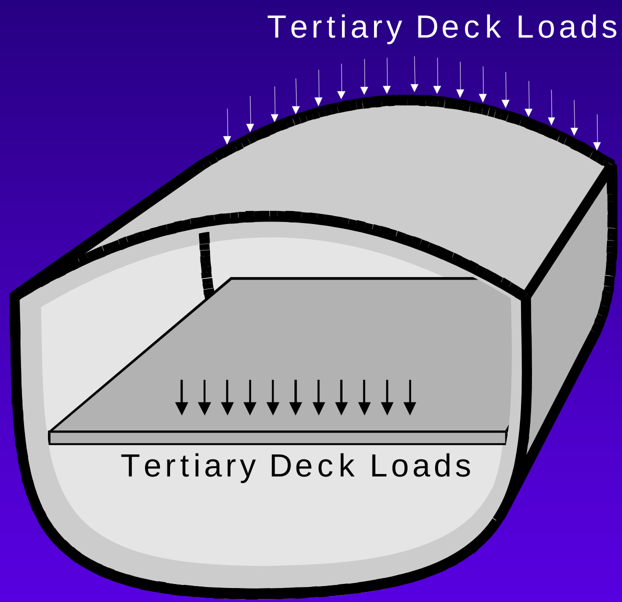
DECK DEPTH RESTRICTIONS
Headroom Requirements
Outfitting Accommodation

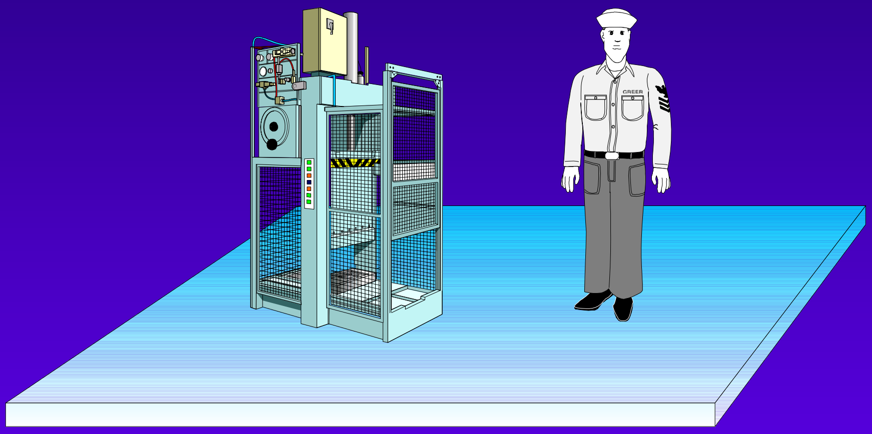
Develop deck structure drawing based on geometric considerations

Develop deck load predictions to determine deck scantlings and materials

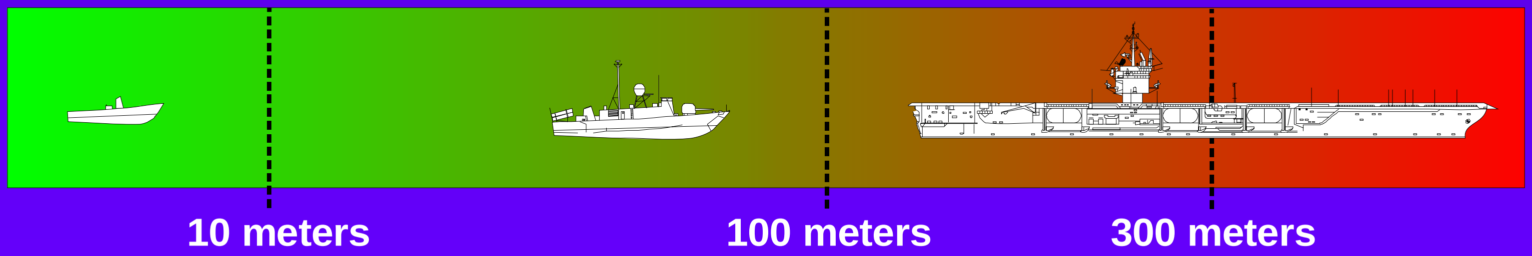
Decks

Static Deck Loads



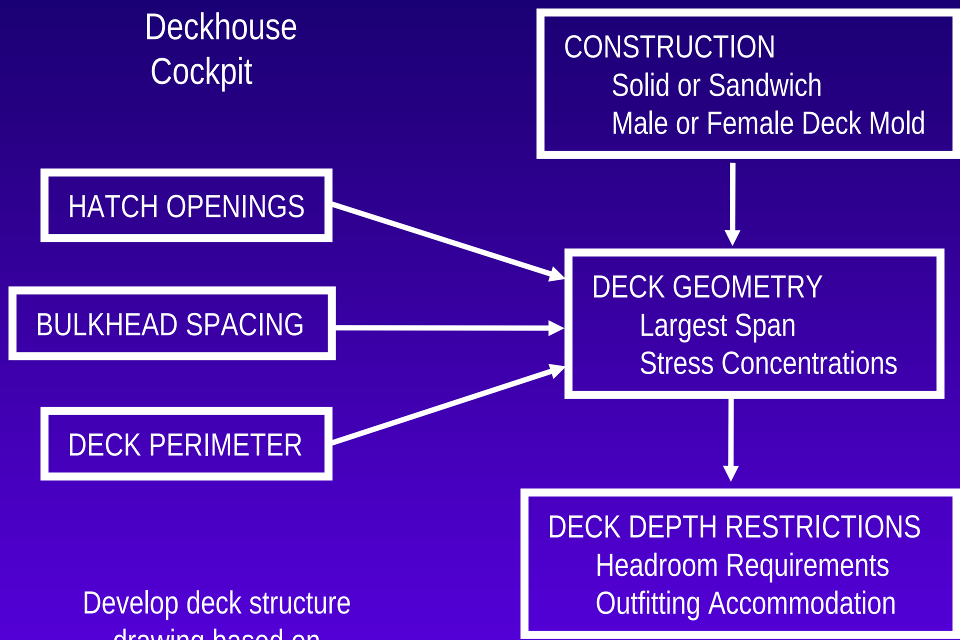


Important for Primary Structure → Important for Secondary Structure



Decks

DETERMINE PRELIMINARY ARRANGEMENT
- Deckhouse
- Cockpit



Develop deck structure drawing based on geometric considerations

PRIORITIZE DESIGN GOALS
- Strength
- Stiffness
- Cosmetics
- Cost

CREW, EQUIPMENT & CARGO LOADS
- Weights & Footprints
- Accelerations

GREEN WATER LOAD
- Vessel Geometry
- Sea State

Develop deck load predictions to determine deck scantlings and materials

Decks

Green Water Deck Loads

USCG 47-Foot Motor Life Boat 47234 Taking a Wave Head On

Decks

DETERMINE PRELIMINARY ARRANGEMENT
- Deckhouse
- Cockpit

CONSTRUCTION
- Solid or Sandwich
- Male or Female Deck Mold

HATCH OPENINGS

BULKHEAD SPACING

DECK PERIMETER

DECK GEOMETRY
- Largest Span
- Stress Concentrations

DECK DEPTH RESTRICTIONS
- Headroom Requirements
- Outfitting Accommodation

Develop deck structure drawing based on geometric considerations

PRIORITIZE DESIGN GOALS
- Strength
- Stiffness
- Cosmetics
- Cost

CREW, EQUIPMENT & CARGO LOADS
- Weights & Footprints
- Accelerations

GREEN WATER LOAD
- Vessel Geometry
- Sea State

Develop deck load predictions to determine deck scantlings and materials

FABRICATION
- Producibility
- Material Availability

Decks

Consider Fabrication Issues

Deck Layup at Beneteau USA

Deck Overhead Liner Beneteau USA

Deck Being Molded at Sabre Yachts

Installation of Deck Hardware at Sabre Yachts

Decks

DETERMINE PRELIMINARY ARRANGEMENT
Deckhouse
Cockpit

CONSTRUCTION
Solid or Sandwich
Male or Female Deck Mold

PRIORITIZE DESIGN GOALS
Strength
Stiffness
Cosmetics
Cost

HATCH OPENINGS

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CREW, EQUIPMENT & CARGO LOADS
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GREEN WATER LOAD
Vessel Geometry
Sea State

DECK DEPTH RESTRICTIONS
Headroom Requirements
Outfitting Accommodation

Develop deck structure drawing based on geometric considerations

Develop deck load predictions to determine deck scantlings and materials

FABRICATION
Producibility
Material Availability

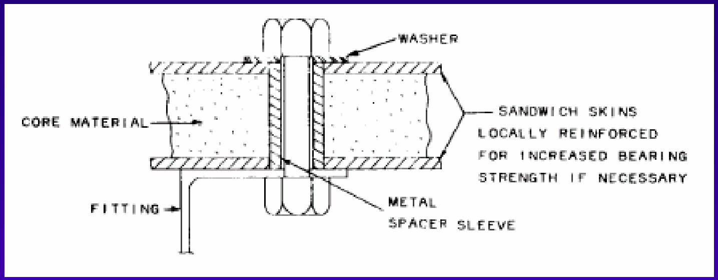
REINFORCEMENTS for HARDWARE

IN-SERVICE HEAT EXPOSURE

NON-SKID REQUIREMENTS

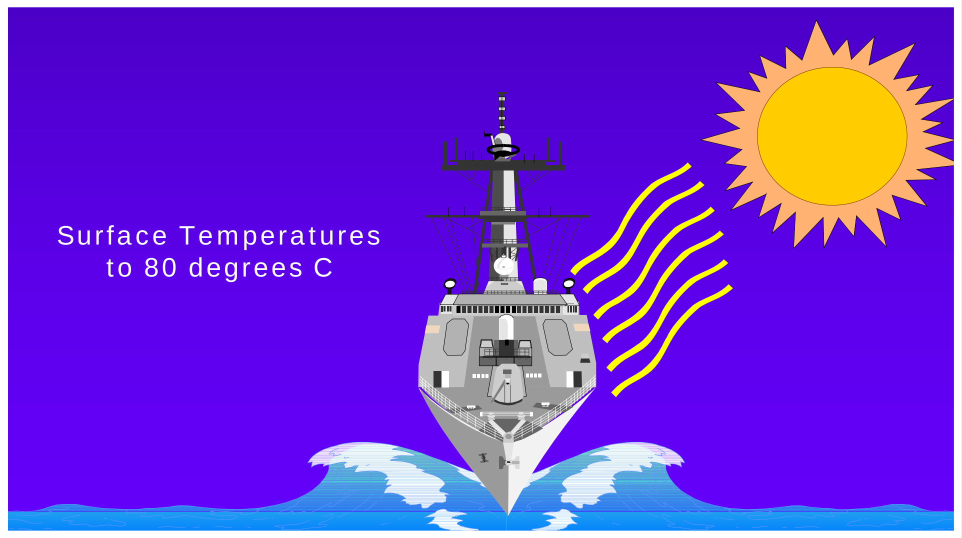
Decks

Consider Hardware, Surface Treatment and Environmental Effects



Detail for Through-Bolting in Sandwich Construction

Rough Weather Sailing on Djuice Dragons Requires Good Non-Skid Deck



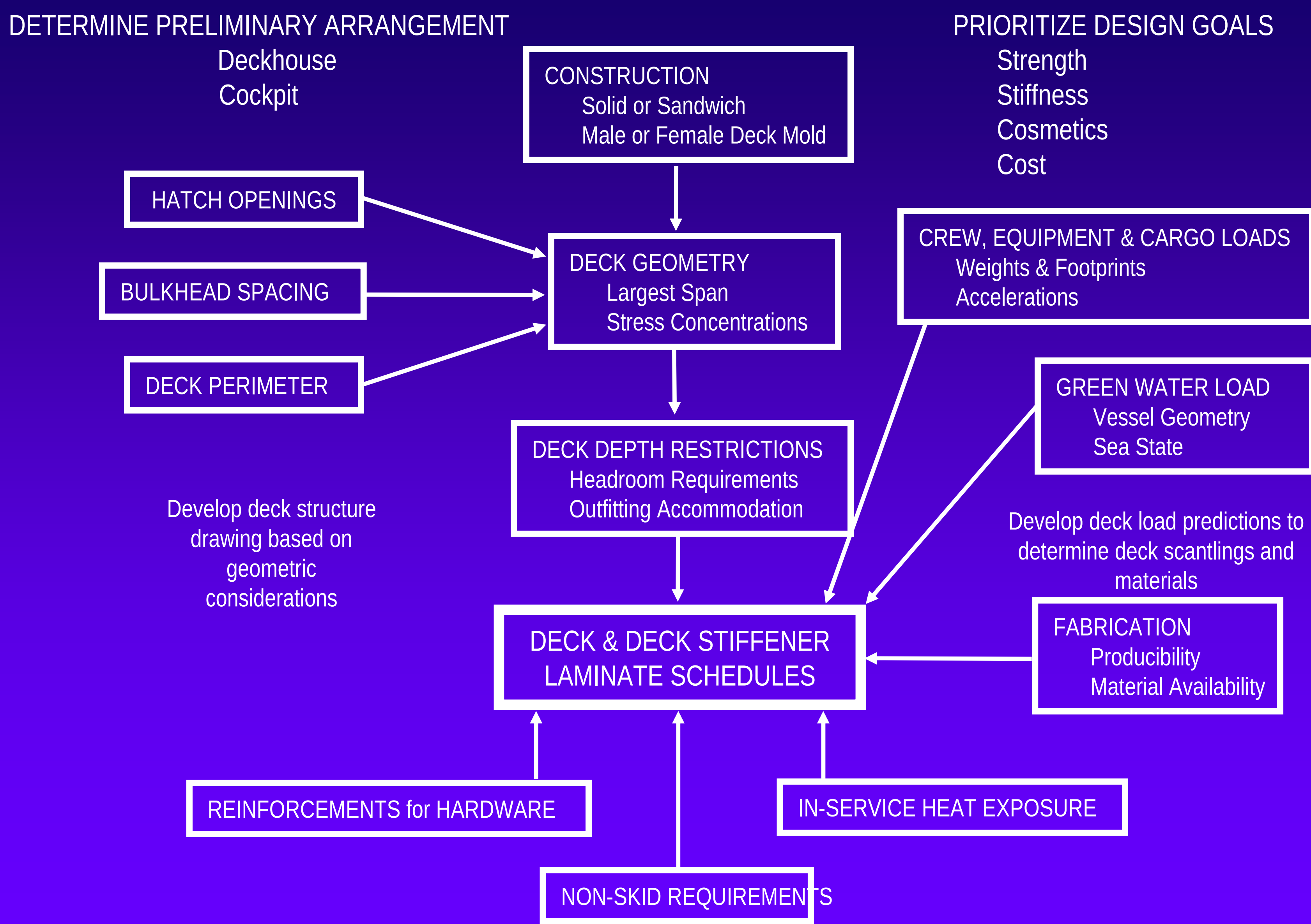
Elevated Surface Temperature Considerations for Composite DDG 51 Forward Director Room

Decks

Young America, November 9, 1999

Video Courtesy of Jeff Eckland

Decks


DETERMINE PRELIMINARY ARRANGEMENT
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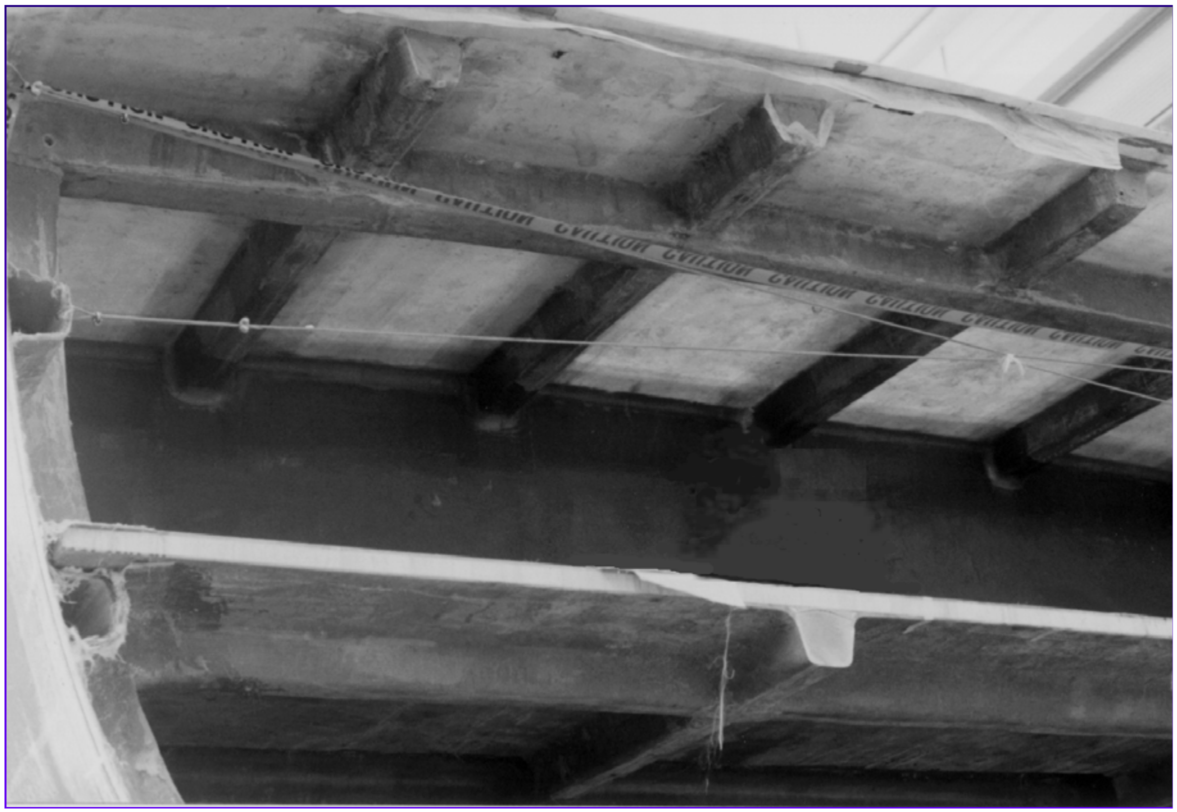
DECK & DECK STIFFENER LAMINATE SCHEDULES
FABRICATION
Producibility
Material Availability
REINFORCEMENTS for HARDWARE
IN-SERVICE HEAT EXPOSURE
NON-SKID REQUIREMENTS

Decks

Deck and Stiffener Laminates



Prototype Corvette Deck Structure Built for the
U.S Navy by Sunrez Using UV-Cured Resin