STRUCTURE

Basics

The structure of the vehicle is that portion of its mass responsible for holding the various pieces together, along with any parts of other vehicle categories that are affected by overall vehicle mass. It may, but is not required to be structural elements.

Configurations

Vehicles can come in an infinite number of shapes, each with a particular surface area, volume and relative dimensions. This makes volume and armor calculations a potential infinite headache. To reduce this, the following table lists a useful subset of vehicle shapes, along with other handy information. For this table, length(l) is always assumed to be 1, and the width(w) and depth(d) are the fractions of total length that apply. Area is the total vehicle area in square meters for a length of l meters. Volume is the total vehicle volume in cubic meters for a length of l meters. Front(F), Rear(R), Side(S)(each), Top(T), Bottom(B) are the fractions of total area that these facings take up.

Type	l	w	d	Area/Vol	F	R	S	T	B
Sphere	1.0	1.0	1.0	$A = l^2 \times 3.1$	.17	.17	.16	.17	.17
				$V = l^3 \times .52$					
Cube	1.0	1.0	1.0	$A = l^2 \times 6.0$	.17	.17	.16	.17	.17
				$V = l^3$					
Slab	1.0	.50	.25	$A = l^2 \times 1.76$	.07	.07	.15	.28	.28
				$V = l^3 \times .13$					
Box_1	1.0	.50	.40	$A = l^2 \times 2.2$	.09	.09	.19	.22	.22
				$V = l^3 \times .20$					
Box_2	1.0	.20	.15	$A = l^2 \times .76$	.04	.04	.20	.26	.26
				$V = l^3 \times .03$					
$Cylinder_1$	1.0	.20	.20	$A = l^2 \times .69$	.05	.05	.23	.22	.22
				$V = l^3 \times .03$					
$Cylinder_2$	1.0	.10	.10	$A = l^2 \times .33$	.03	.03	.24	.23	.23
				$V = l^3 \times .008$					
Half cyl.$_1$	1.0	.20	.10	$A = l^2 \times .55$	.02	.02	.20	.36	.20
				$V = l^3 \times .016$					
Half cyl.$_2$	1.0	.10	.05	$A = l^2 \times .27$	.01	.01	.20	.38	.20
				$V = l^3 \times .004$					
$Prism_1$	1.0	.30	.15	$A = l^2 \times .60$	.08	.08	.11	.50	.12
				$V = l^3 \times .045$					
$Prism_2$	1.0	.10	.05	$A = l^2 \times .25$	.02	.02	.18	.40	.20
				$V = l^3 \times .005$					
Disk	1.0	1.0	.25	$A = l^2 \times 2.4$	.09	.09	.08	.33	.33
				$V = l^3 \times .20$					
Wedge	1.0	.60	.30	$A = l^2 \times .75$	.18	.12	.17	.18	.18
				$V = l^3 \times .03$					

Most vehicles with wings will have an additional surface area taken up by aerodynamic surfaces. The designer may choose to either treat these as having armor like the body of the vehicle (top and bottom facings only), or to be separate from the body of the vehicle in terms of AV, in which case these surfaces are covered/armored separately. This extra surface will not affect the vehicle's internal volume, but see **Surface Treatments** (**p.55**) for more details.

Example - You decide to design a car, and figure it is about 4 meters long. Selecting the Box_1 configuration, you find that it has a total area of $4^2 \times 1.1 = 17.6$ square meters, a total volume of $4^3 \times .2 = 12.8$ cubic meters and dimensions of 4m x 2m x 1.6m. If you wanted to armor it, and put a different amount on the front, you could see that the front area of the car is .09 x 17.6 = 1.58 square meters (round to 1.6 square meters).

ℹ A more comprehensive listing of vehicle dimensions is in the tables in the back of the rules.

5 STRUCTURE

Basics

The structure of the vehicle is that portion of its mass responsible for holding the various pieces together, along with any parts of other vehicle categories that are affected by overall vehicle mass. It may, but is not required to be structural elements.

Configurations

Vehicles can come in an infinite number of shapes, each with a particular surface area, volume and relative dimensions. This makes volume and armor calculations a potential infinite headache. To reduce this, the following table lists a useful subset of vehicle shapes, along with other handy information. For this table, length(l) is always assumed to be 1, and the width(w) and depth(d) are the fractions of total length that apply. Area is the total vehicle area in square meters for a length of l meters. Volume is the total vehicle volume in cubic meters for a length of l meters. Front(F), Rear(R), Side(S)(each), Top(T), Bottom(B) are the fractions of total area that these facings take up.

Type	l	w	d	Area/Vol	F	R	S	T	B
Sphere	1.0	1.0	1.0	$A = l^2 \times 3.1$ $V = l^3 \times .52$	.17	.17	.16	.17	.17
Cube	1.0	1.0	1.0	$A = l^2 \times 6.0$ $V = l^3$	.17	.17	.16	.17	.17
Slab	1.0	.50	.25	$A = l^2 \times 1.76$ $V = l^3 \times .13$	.07	.07	.15	.28	.28
Box_1	1.0	.50	.40	$A = l^2 \times 2.2$ $V = l^3 \times .20$	.09	.09	.19	.22	.22
Box_2	1.0	.20	.15	$A = l^2 \times .76$ $V = l^3 \times .03$	.04	.04	.20	.26	.26
$Cylinder_1$	1.0	.20	.20	$A = l^2 \times .69$ $V = l^3 \times .03$	.05	.05	.23	.22	.22
$Cylinder_2$	1.0	.10	.10	$A = l^2 \times .33$ $V = l^3 \times .008$	.03	.03	.24	.23	.23
Half cyl.$_1$	1.0	.20	.10	$A = l^2 \times .55$ $V = l^3 \times .016$	.02	.02	.20	.36	.20
Half cyl.$_2$	1.0	.10	.05	$A = l^2 \times .27$ $V = l^3 \times .004$	.01	.01	.20	.38	.20
$Prism_1$	1.0	.30	.15	$A = l^2 \times .60$ $V = l^3 \times .045$	.08	.08	.11	.50	.12
$Prism_2$	1.0	.10	.05	$A = l^2 \times .25$ $V = l^3 \times .005$	.02	.02	.18	.40	.20
Disk	1.0	1.0	.25	$A = l^2 \times 2.4$ $V = l^3 \times .20$	.09	.09	.08	.33	.33
Wedge	1.0	.60	.30	$A = l^2 \times .75$ $V = l^3 \times .03$	.18	.12	.17	.18	.18

Most vehicles with wings will have an additional surface area taken up by aerodynamic surfaces. The designer may choose to either treat these as having armor like the body of the vehicle (top and bottom facings only), or to be separate from the body of the vehicle in terms of AV, in which case these surfaces are covered/armored separately. This extra surface will not affect the vehicle's internal volume, but see **Surface Treatments** (**p.55**) for more details.

Example - You decide to design a car, and figure it is about 4 meters long. Selecting the Box_1 configuration, you find that it has a total area of $4^2 \times 1.1 = 17.6$ square meters, a total volume of $4^3 \times .2 = 12.8$ cubic meters and dimensions of 4m x 2m x 1.6m. If you wanted to armor it, and put a different amount on the front, you could see that the front area of the car is $.09 \times 17.6 = 1.58$ square meters (round to 1.6 square meters).

🛈 A more comprehensive listing of vehicle dimensions is in the tables in the back of the rules.

Am I Doing This Right?

Question #1:

What is the structure mass and cost of a TL9 automobile which uses the Box$_1$ configuration and (length of 4m), has a loaded mass of 1,000kg, a Turn of 6 and Acceleration of 5?

Calculations:

The "structure AV" of the car is the square root of (its mass in *tons* times the *greater* of Turn/10 or Acceleration/10), or 1. However, a land vehicle has to have a structure AV of at least its suspension rating plus 1. Since a regular car has a suspension rating of 1, the minimum structure AV is 2. A Box$_1$ vehicle 4m long has an area of 35.2m^2. At TL9, 10mm of structure has an AV of 11, so we need 2/11th this amount, or (using composite structure) 35.2m^2 x 50kg per m^2 x 2/11 = 320kg. Cost is also 2/11th normal, or 35.2m^2 x 500Cr per m^2 x 2/11 = 3,200Cr. For damaging the structure, the AV is x5 the calculated amount, of AV2 x 5 = AV10.

Answers:
Structure mass = 320kg
Structure cost = 3,200Cr
Structure AV = 10

Question #2:

What volume and mass does a school bus require for driver and passengers? Assume 1 driving station and 60 passengers, all substandard seats. If it has 2m standing room and is 2.5m wide, how long is the passenger compartment?

Calculations:

We'll assume this is 60 adult-size seats (probably 90 child-size seats). Each passenger takes up 1m^3, for a total of 60m^3, with each seat massing 10kg and costing 50Cr, for a total passenger seating mass of 600kg and cost of 3,000Cr. The driver station has the same size, cost and mass as a single passenger seat, so this is added to the total, for 61m^3, 610kg and 3,050Cr. Dividing 61m^3 by 2m of height and 2.5m of width gives (61m^3/(2.5m x 2.0m)) = 12.2m of length.

Answers:
Volume = 61m^3
Mass = 610kg
Length of passenger compartment = 12.2m

Question #3:

If a nuclear attack submarine has a total complement of 120, with the following mix:

Captain (1)	Basic quarters
Other officers (9)	Minimum quarters
Crew (110)	Stacked bunks

How much volume will quarters, toilets, showers, galley, crew stations, a common area sufficient to seat two-thirds of the crew, two storage rooms, one torpedo room, and one control room (common area) sufficient to seat 10 take up?

Calculations:

The captain's basic quarters will have a volume of 20m^3. Each other officer's quarters will have a volume of 10m^3, for a total of 90m^3. The stacked bunks will have a volume of 2m^3 each for a total of 220m^3. The total for quarters is 20m^3 + 90m^3 + 220m^3 = 330m^3.

Using the guidelines of one toilet at 2m^3 per 20 passengers and one shower at 2m^3 per 20 passengers, this is (120 passengers/20) x (2m^3 + 2m^3) = 24m^3. We double this to 48m^3 because most of the use will be in groups between shifts.

The galley serves 3 meals/day to 120 people, or 360 meals per day. We can divide this by 24 hours to get a number of meals per hour, which is 15. At 4 meals per hour per 2m^3, we can round this up to 8m^3 required for food preparation. Note that this does not include any food storage space. This space would assume that food is being prepared constantly and stored for use at a designation mealtime. It would be more realistic to assume that say half the time available is used, and double the space, or 16m^3. This means that 30 meals can be prepared per hour. We add 10m^3 for each of two storage rooms, making the total volume 36m^3.

Crew stations are assumed to be like vehicle controls, and are 1m^3 per person, for a total of 120m^3. However, only half the crew is on duty at any time, so this is halved to 60m^3.

A common area for two-thirds of the crew (80 people) would be an additional 80m^3. This leaves room to move around for crew that is currently not on duty. The control room common area is another 10m^3, and we allot 40m^3 for a torpedo room.

Accessways are narrow hallways at 1.5m^3 per 1m of length, and the number of "rooms" is 10 (officer's quarters) + 28 (bunks) + 1 (showers) + 3 (galley + storage) + 1 (torpedo room) + 1 control room + 1 (common area) +1 (torpedo room) = 46, times 1.5m^3 = 69m^3 of accessways.

The total for all these is 330m^3 (crew) + 48m^3 (sanitary facilities) + 36m^3 (galley, storage) + 60m^3 (crew stations) + 130m^3 (common, control, torpedo room) + 69m^3 (access) = 673m^3.

Answers:
Total volume required = 673m^3

AM I DOING THIS RIGHT?

Question #1:

What is the mass and cost of composite AV3 structural panels for a TL11 car that is 4.5 meters long? What would they cost if the car had basic streamlining?

Calculations:

Structure panels at TL11 have an AV of 16 per 10mm, so our panels will be 3/16 the mass of 10mm plating, or 1.9mm thick, with a *cost* like they were 5mm thick (minimum cost for armor, p.45). If the car is a Box_1 configuration it has an area of 2.2 x $length^2$ = $44.6m^2$. Since 10mm of default armor has a mass of 50kg, the body panels have a mass of 3/16 x $44.6m^2$ x 50kg = 418kg. Default structure panels cost 125Cr per m^2 that is 10mm thick, so the cost is 8/16 x $44.6m^2$ x 125Cr = 2788Cr. If the car had basic streamlining, the cost would be x1.2, or 2788Cr x 1.2 = 3346Cr.

Answers:
Mass = 418kg
Cost for body = 2788Cr
Cost for basic streamlined body = 3346Cr

Question #2:

What would be the cost and mass of a fully articulated suit of lightweight TL12 armor capable of stopping a heavy assault rifle (AV20)?

Calculations:

This would have the mass of $2m^2$ of TL12 lightweight armor. Since TL12 armor has a default AV of 37 for 10mm and we need an AV of only 10*, we need 20/37 this amount, which is a mass of $2m^2$ x 35kg per $1m^2$ of lightweight armor x 10/37 = 20kg. The cost is x2.5 for full articulation and x 2 for lightweight armor, or $2m^2$ x 500Cr per $1m^2$ x 2 for lightweight armor x 2.5 for articulation x 10/37 = 1,351Cr.

Answers:
Mass = 20kg
Cost = 1,351Cr

*Note - Since you add a blunt trauma factor to the AV of worn armor, the final armor rating of the would probably be listed as an AV of 10/10 or 16/4 (which adds up to AV20).

Question #3:

If you have a 500kw jet engine in a 5,000kg aircraft, what are its final stall speed and top speed if it has $20m^2$ of wings and partial optimum streamlining? If the aircraft has an area (sans wings) of $100m^2$ and a structure mass of 1,000kg, how much does the structure of the wings mass?

Calculations:

The base speed of the plane is (500,000w x 5,000kg)$^{.61}$/5,000kg = 108.1m/sec, x 2 for power train type = 216.2m/sec (778kph/484mph). However, the base speed because of wing drag is (460,000w x 5,000kg)$^{.61}$/5,000kg = 102.7m/sec, x 2 for power train type = 205.4m/sec (740kph/460mph). An air vehicle with partial optimum streamlining will lose 1m/sec per 16m/sec of top speed, so the adjusted top speed is reduced by 12m/sec to 193.4m/sec (696kph/433mph). Stall speed is not affected by streamlining, and is (5,000kg$^{.5}$/$20m^2$)$^{.5}$ x 50m/sec =94m/sec (338kph/208mph). Since wing area is 20% of the hull area ($20m^2$ vs. $100m^2$), the structure of the wings has 20% of the plane's structure mass, or 200kg.

Answers:
Stall speed: 94m/sec
Adjusted top speed: 156m/sec
Wing structure mass: 200kg

Question #4:

What percentage of extra structure mass is needed for a submarine capable of reaching the deepest portions of Earth's oceans (≈11,000m)? What is the effective AV of the hull of this vessel?

Calculations:

If basic pressure sealing is x.1 structure mass, every 10m of depth is 1 atmosphere of pressure, and structure mass is doubled every time pressure is doubled, then we have to see how many doublings of 10m it takes to reach 11,000m. Ten doublings reaches 10,240 meters, but we need a little more than that, or 11 doublings. Using the 1-2-4-8 progression, 11 doublings of x.1 is x204.8 normal structure mass, and if each one gives an effective AV of 5, then the structure alone is +55AV to the vehicle.

Answers:
Additional structure mass: x204.8 normal structure mass
Additional structural AV: +55

Note - If the pressure hull was a 3.5 meter TL10 sphere stressed to an acceleration and Turn of 1, and loaded mass of the pressure hull was 36 tons, it would have a normal structure mass of about 148kg, and volume (composite *armor*) of $.029m^3$. With the x204.8 extra for pressure sealing, the total would be 30.5 tons and $6.1m^3$ used for pressure sealing alone. However, the extra strength imparted would give the vehicle safety against an acceleration or Turn of up to 14 (the square root of the structure multiple).

TL11: Abrams M1A2

Everybody loves the M1 tank. Except maybe the Iraqis. It's big, it's angular, it's fast and it's got a sexy turbine engine instead of a clunky diesel. And aside from the exact details on the armor, we also have a lot of solid info on it.

The **VDS** figures for the M1A2 are based on multiple Slab configurations, a 7.0m long slab for the body and a pair of 3.0m slabs for the turret, ignoring the bottom and touching sides of the turret pieces. Armor is sloped 50° on the front (x1.56 effective thickness), increasing total vehicle length to 8.1m. Because of the overall thickness of the armor we include it as part of the volume calculations. To keep things manageable, the armor on the turret facings is the same as the vehicle facings, though technically the turret is sloped.

The 120mm cannon and secondary armament we have real world figures for, and they have been used instead of the formula-based ones.

Special effects - The armor is "heavy armor" but is bought as "composite armor" because it includes lightweight technologies to defeat shaped charges. You can reduce the AV on a facing by 9 to give it +30AV vs. shaped charges, for instance, making an AV of 100 into an AV of 91(121), where the AV of 121 applies vs. shaped charges and the 91 vs. everything else. Since we don't know the exact amount, use this proportion as many or as few times as you wish (within reason) to personal taste. The power train has been given 1 level of redundant systems and should be bought as being able to turn in place. There is not room in the next column to list all the accessories the tank has, such as cargo racks, spare parts, food & water stores, smoke dischargers (ECM), etc. The bulkheads (4) of the vehicle separate the crew, engine, fuel and ammunition with AV30 partitions, and the ammunition storage is designed to rupture panels on the outside of the vehicle rather than blowing through the internal bulkhead. The remaining internal volume on the VDS version is largely illusionary and based on inexact representation of the hull and turrent configuration.

Campaign notes - Can it *really* go 73mph? Probably not, but it is said to go *a lot* faster than the 45mph figure quoted as the "official" top speed. The truth? Somewhere in between, we suspect.

The damage of the weapons and toughness of the armor are an example of why **VDS** is not all that great from a purely role-playing standpoint. If you've got weapons that can penetrate the armor, the vehicle is probably cooked. Even if the toughness and bulkheads protect it somewhat, a 700 point hit to a 600 point side armor could still send 100 points into the crew compartment, which is a lot more painful than a 7 point bullet hitting 6 points of body armor. It also brings up the question of gamemaster escalation. If you're riding around in a tank, expect to be shot at with anti-tank weapons...

Specifications:

Configuration:	Slab, basic streamlining		
Length:	8.1m	Size modifier:	-3
Width:	3.5m	Toughness:	x.25
Depth:	2.6m		

	Area	Volume	Mass
Design figures:	103.7m^2	51.6m^3	66,000kg
Power plant:	AV8, TL11 enhanced (w/radiators)		
Stats:	1,125.0kw 4.5m^2	1.6m^3	1,550kg
Power train:	AV66, TL11 tracksw/skirts (terrain rating 4)		
Stats:	12.3m^2	24.5m^3	12,272kg
Redundant sys.x 1	1.2m^2	2.5m^3	1,227kg
Stabilizers (1 pt)	-	2.5m^3	1,227kg
Fuel:	Most liquid hydrocarbons (normal fuel), 4.7 hours		
Stats:	-	1.9m^3	1,460kg
Structure:	None needed due to level of armor		
Environ. sealing, bulkheads(4)	-	.01m^3	165kg
Surface:	TL11 heavy armor		
Front (250mm sloped, AV1210)	-	2.05m^3	10,258kg
Rear (71mm, AV200)	-	.58m^3	2,913kg
R.side (129mm, AV400)	-	1.96m^3	9,819kg
L.side (129mm, AV400)	-	1.96m^3	9,819kg
Top (25mm, AV78)	-	.82m^3	4,130kg
Bottom (40mm, AV124)	-	.96m^3	4,802kg
Basic streamlining:	-	-	-
Weapon:	120mm cannon (DV=946, RMod=38 (HEAT rounds))		
Stats:	-	3.0m^3	3,020kg
Ammunition: 40 shots	-	.92m^3	920kg
Weapon:	12.7mm machinegun (DV=36, RMod=10)		
Stats:	-	.06m^3	60kg
Ammunition: 900 shots	-	.09m^3	90kg
Weapon:	7.62mm machinegun x 2 (DV=19, RMod=4)		
Stats:	-	.04m^3	40kg
Ammunition:12,000 shots	-	.35m^3	350kg
Crew (w/seats):			
Commander, loader, gunner, driver:		4.0m^3	400kg
Other:			
Climate control, +/-20°C	-	.04m^3	40kg
Maintenance tools	-	.16m^3	326kg
Rating 1 computer	-	.08m^3	80kg
Disaster system(fire suppres.)	-	.06m^3	56kg
Rating 2 thermal sensor	.2m^2	.10m^3	100kg
Rating 2 laser detector	.2m^2	.04m^3	40kg
Rating 2 communicator	2.0m^2	.05m^3	50kg
Subtotals:	20.4m^2	50.3m^3	65,214kg
Spare capacity:	83.3m^2	1.3m^3	786kg

Performance:

Base top speed:	58m/sec (208kph/129mph)
Adjusted:	32m/sec (117kph/73mph)
Base acceleration:	2.6
Adjusted:	2.6
Base deceleration:	2.2
Adjusted:	6.4
Base Turn Mode:	5
Adjusted:	4

Configurations
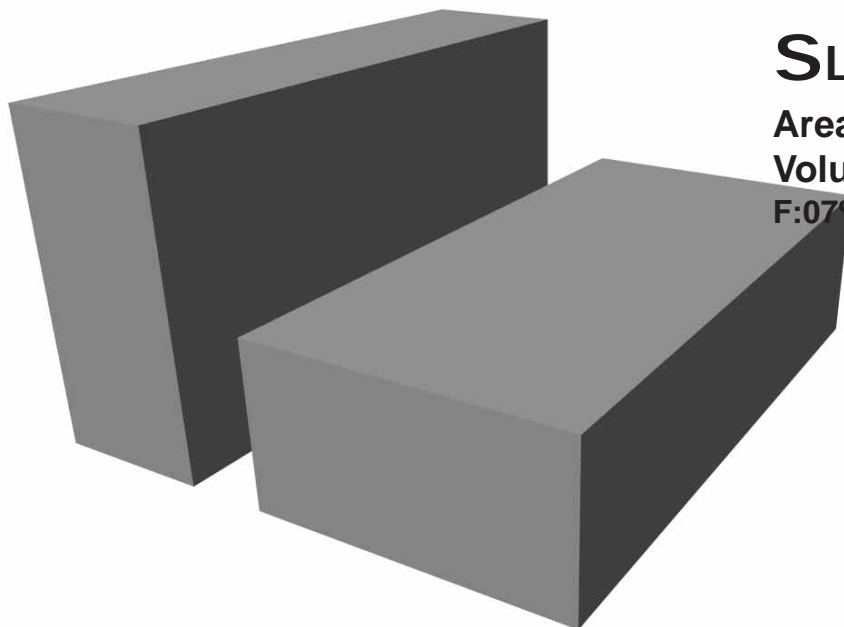
SLAB

Area = Length^2 x 1.75
Volume = Length^3 x .13
F:07% R:07% S:15% T:28% B:28%

Length	Volume	Area	Length	Width	Depth	Front area	Rear area	Side area (ea.)	Top area	Bottom area
.50m	.016m^3	.438m^2	.50m	.25m	.13m	.031m^2	.031m^2	.066m^2	.122m^2	.122m^2
1.0m	.130m^3	1.75m^2	1.0m	.50m	.25m	.122m^2	.122m^2	.263m^2	.490m^2	.490m^2
1.5m	.439m^3	3.94m^2	1.5m	.75m	.38m	.276m^2	.276m^2	.591m^2	1.10m^2	1.10m^2
2.0m	1.04m^3	7.00m^2	2.0m	1.0m	.50m	.490m^2	.490m^2	1.05m^2	1.96m^2	1.96m^2
3.0m	3.51m^3	15.80m^2	3.0m	1.5m	.75m	1.10m^2	1.10m^2	2.36m^2	4.41m^2	4.41m^2
4.0m	8.32m^3	28.00m^2	4.0m	2.0m	1.0m	1.96m^2	1.96m^2	4.20m^2	7.84m^2	7.84m^2
5.0m	16.25m^3	43.75m^2	5.0m	2.5m	1.3m	3.06m^2	3.06m^2	6.56m^2	12.3m^2	12.3m^2
6.0m	28.08m^3	63.00m^2	6.0m	3.0m	1.5m	4.41m^2	4.41m^2	9.45m^2	17.6m^2	17.6m^2
7.0m	44.59m^3	85.75m^2	7.0m	3.5m	1.8m	6.00m^2	6.00m^2	12.9m^2	24.0m^2	24.0m^2
8.0m	66.56m^3	112.0m^2	8.0m	4.0m	2.0m	7.84m^2	7.84m^2	16.8m^2	31.4m^2	31.4m^2
10m	130.0m^3	175.0m^2	10.0m	5.0m	2.5m	12.2m^2	12.2m^2	26.3m^2	49.0m^2	49.0m^2
12m	224.6m^3	252.0m^2	12.0m	6.0m	3.0m	17.6m^2	17.6m^2	37.8m^2	70.6m^2	70.6m^2
15m	438.8m^3	393.8m^2	15.0m	7.5m	3.8m	27.6m^2	27.6m^2	59.1m^2	110.2m^2	110.2m^2
20m	1040.m^3	700.0m^2	20.0m	10.0m	5.0m	49.0m^2	49.0m^2	105.0m^2	196.0m^2	196.0m^2
25m	2031.m^3	1094.m^2	25.0m	12.5m	6.3m	76.6m^2	76.6m^2	164.1m^2	306.3m^2	306.3m^2
30m	3510.m^3	1575.m^2	30.0m	15.0m	7.5m	110.3m^2	110.3m^2	236.3m^2	441.0m^2	441.0m^2
35m	5574.m^3	2144.m^2	35.0m	17.5m	8.8m	150.1m^2	150.1m^2	321.6m^2	600.3m^2	600.3m^2
40m	8320.m^3	2800.m^2	40.0m	20.0m	10.0m	196.0m^2	196.0m^2	420.0m^2	784.0m^2	784.0m^2
45m	11846m^3	3544.m^2	45.0m	22.5m	11.3m	248.1m^2	248.1m^2	531.6m^2	992.3m^2	992.3m^2
50m	16250m^3	4375.m^2	50.0m	25.0m	12.5m	306.3m^2	306.3m^2	656.2m^2	1225.m^2	1225.m^2
60m	28080m^3	6300.m^2	60.0m	30.0m	15.0m	441.0m^2	441.0m^2	945.0m^2	1764.m^2	1764.m^2
70m	44590m^3	8575.m^2	70.0m	35.0m	17.5m	600.3m^2	600.3m^2	1286.m^2	2401.m^2	2401.m^2
80m	66560m^3	11200m^2	80.0m	40.0m	20.0m	784.0m^2	784.0m^2	1680.m^2	3136.m^2	3136.m^2
90m	94770m^3	14175m^2	90.0m	45.0m	22.5m	992.3m^2	992.3m^2	2126.m^2	3969.m^2	3969.m^2
100m	130000m^3	17500m^2	100.0m	50.0m	25.0m	1225.m^2	1225.m^2	2625.m^2	4900.m^2	4900.m^2
120m	224640m^3	25200m^2	120.0m	60.0m	30.0m	1764.m^2	1764.m^2	3780.m^2	7056.m^2	7056.m^2
150m	438750m^3	39375m^2	150.0m	75.0m	37.5m	2756.m^2	2756.m^2	5906.m^2	11025m^2	11025m^2
200m	1.04 x 10^{6}m^3	70000m^2	200.0m	100.0m	50.0m	4900.m^2	4900.m^2	10500m^2	19600m^2	19600m^2
250m	2.03 x 10^{6}m^3	109400m^2	250.0m	125.0m	62.5m	7656.m^2	7656.m^2	16406m^2	30625m^2	30625m^2
300m	3.51 x 10^{6}m^3	157500m^2	300.0m	150.0m	75.0m	11025m^2	11025m^2	23625m^2	44100m^2	44100m^2
400m	8.32 x 10^{6}m^3	280000m^2	400.0m	200.0m	100.0m	19600m^2	19600m^2	42000m^2	78400m^2	78400m^2
500m	16.3 x 10^{6}m^3	437500m^2	500.0m	250.0m	125.0m	30625m^2	30625m^2	65625m^2	122500m^2	122500m^2
600m	28.1 x 10^{6}m^3	630000m^2	600.0m	300.0m	150.0m	44100m^2	44100m^2	94500m^2	176400m^2	176400m^2
700m	44.6 x 10^{6}m^3	857500m^2	700.0m	350.0m	175.0m	60025m^2	60025m^2	128625m^2	240100m^2	240100m^2
800m	66.6 x 10^{6}m^3	1.12 x 10^{6}m^2	800.0m	400.0m	200.0m	78400m^2	778400m^2	168000m^2	313600m^2	313600m^2
900m	94.8 x 10^{6}m^3	1.42 x 10^{6}m^2	900.0m	450.0m	225.0m	99225m^2	99225m^2	212625m^2	396900m^2	396900m^2
1000m	130 x 10^{6}m^3	1.75 x 10^{6}m^2	1000.0m	500.0m	250.0m	122500m^2	122500m^2	262500m^2	490000m^2	490000m^2
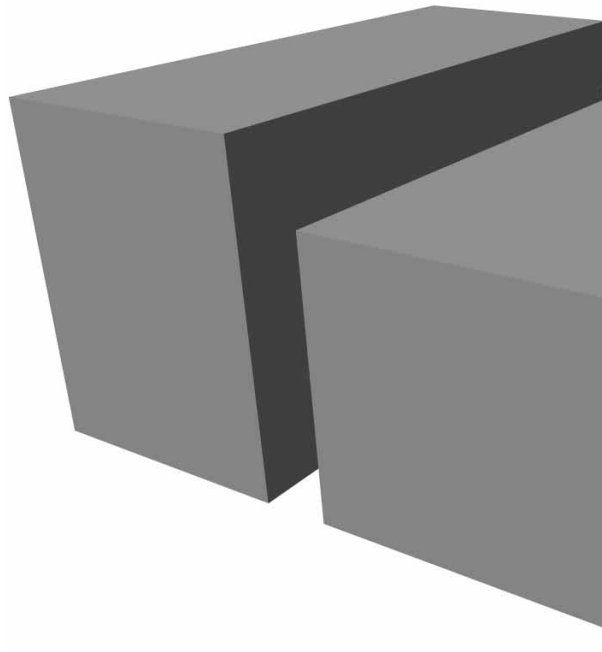
Box$_1$

Area = Length^2 x 2.2
Volume = Length^3 x .20
F:09% R:09% S:19% T:22% B:22%

Length	Volume	Area	Length	Width	Depth	Front area	Rear area	Side area (ea.)	Top area	Bottom area
.50m	.025m^3	.550m^2	.50m	.25m	.20m	.050m^2	.050m^2	.104m^2	.121m^2	.121m^2
1.0m	.200m^3	2.20m^2	1.0m	.50m	.40m	.198m^2	.198m^2	.418m^2	.484m^2	.484m^2
1.5m	.675m^3	4.95m^2	1.5m	.75m	.60m	.445m^2	.445m^2	.941m^2	1.09m^2	1.09m^2
2.0m	1.60m^3	8.80m^2	2.0m	1.0m	.80m	.792m^2	.792m^2	1.67m^2	1.94m^2	1.94m^2
3.0m	5.40m^3	19.80m^2	3.0m	1.5m	1.2m	1.78m^2	1.78m^2	3.76m^2	4.36m^2	4.36m^2
4.0m	12.8m^3	35.20m^2	4.0m	2.0m	1.6m	3.17m^2	3.17m^2	6.69m^2	7.74m^2	7.74m^2
5.0m	25.0m^3	55.00m^2	5.0m	2.5m	2.0m	4.95m^2	4.95m^2	10.5m^2	12.1m^2	12.1m^2
6.0m	43.2m^3	79.20m^2	6.0m	3.0m	2.4m	7.13m^2	7.13m^2	15.0m^2	17.4m^2	17.4m^2
7.0m	68.6m^3	107.8m^2	7.0m	3.5m	2.8m	9.70m^2	9.70m^2	20.5m^2	23.7m^2	23.7m^2
8.0m	102.4m^3	140.8m^2	8.0m	4.0m	3.2m	12.7m^2	12.7m^2	26.7m^2	31.0m^2	31.0m^2
10m	200.0m^3	220.0m^2	10.0m	5.0m	4.0m	19.8m^2	19.8m^2	41.8m^2	48.4m^2	48.4m^2
12m	345.6m^3	316.8m^2	12.0m	6.0m	4.8m	28.5m^2	28.5m^2	60.2m^2	69.7m^2	69.7m^2
15m	675.0m^3	495.0m^2	15.0m	7.5m	6.0m	44.6m^2	44.6m^2	94.0m^2	108.9m^2	108.9m^2
20m	1600.m^3	880.0m^2	20.0m	10.0m	8.0m	79.2m^2	79.2m^2	167.2m^2	193.6m^2	193.6m^2
25m	3125.m^3	1375.m^2	25.0m	12.5m	10.0m	123.8m^2	123.8m^2	261.2m^2	302.5m^2	302.5m^2
30m	5400.m^3	1980.m^2	30.0m	15.0m	12.0m	178.2m^2	178.2m^2	376.2m^2	435.6m^2	435.6m^2
35m	8575.m^3	2695.m^2	35.0m	17.5m	14.0m	242.6m^2	242.6m^2	512.0m^2	592.9m^2	592.9m^2
40m	12800m^3	3520.m^2	40.0m	20.0m	16.0m	316.8m^2	316.8m^2	668.8m^2	774.4m^2	774.4m^2
45m	18225m^3	4455.m^2	45.0m	22.5m	18.0m	401.0m^2	401.0m^2	846.4m^2	980.1m^2	980.1m^2
50m	25000m^3	5500.m^2	50.0m	25.0m	20.0m	495.0m^2	495.0m^2	1045.m^2	1210.m^2	1210.m^2
60m	43200m^3	7920.m^2	60.0m	30.0m	24.0m	712.8m^2	712.8m^2	1505.m^2	1742.m^2	1742.m^2
70m	68600m^3	10780m^2	70.0m	35.0m	28.0m	970.2m^2	970.2m^2	2048.m^2	2372.m^2	2372.m^2
80m	102400m^3	14080m^2	80.0m	40.0m	32.0m	1267.m^2	1267.m^2	2675.m^2	3098.m^2	3098.m^2
90m	145800m^3	17820m^2	90.0m	45.0m	36.0m	1604.m^2	1604.m^2	3386.m^2	3920.m^2	3920.m^2
100m	200000m^3	22000m^2	100.0m	50.0m	40.0m	1980.m^2	1980.m^2	4180.m^2	4840.m^2	4840.m^2
120m	345600m^3	31680m^2	120.0m	60.0m	48.0m	2851.m^2	2851.m^2	6019.m^2	6970.m^2	6970.m^2
150m	675000m^3	49500m^2	150.0m	75.0m	60.0m	4455.m^2	4455.m^2	9405.m^2	10890m^2	10890m^2
200m	1.60 x 10^{6}m^3	88000m^2	200.0m	100.0m	80.0m	7920.m^2	7920.m^2	16720m^2	19360m^2	19360m^2
250m	3.13 x 10^{6}m^3	137500m^2	250.0m	125.0m	100.0m	12375m^2	12375m^2	26125m^2	30250m^2	30250m^2
300m	5.40 x 10^{6}m^3	198000m^2	300.0m	150.0m	120.0m	17820m^2	17820m^2	37620m^2	43560m^2	43560m^2
400m	12.8 x 10^{6}m^3	352000m^2	400.0m	200.0m	160.0m	31680m^2	31680m^2	66880m^2	77440m^2	77440m^2
500m	25.0 x 10^{6}m^3	550000m^2	500.0m	250.0m	200.0m	49500m^2	49500m^2	104500m^2	121000m^2	121000m^2
600m	43.2 x 10^{6}m^3	792000m^2	600.0m	300.0m	240.0m	71280m^2	71280m^2	150480m^2	174240m^2	174240m^2
700m	68.6 x 10^{6}m^3	1.08 x 10^{6}m^2	700.0m	350.0m	280.0m	97020m^2	97020m^2	204820m^2	237160m^2	237160m^2
800m	102 x 10^{6}m^3	1.41 x 10^{6}m^2	800.0m	400.0m	320.0m	126720m^2	126720m^2	267520m^2	309760m^2	309760m^2
900m	146 x 10^{6}m^3	1.78 x 10^{6}m^2	900.0m	450.0m	360.0m	160380m^2	160380m^2	338580m^2	392040m^2	392040m^2
1000m	200 x 10^{6}m^3	2.20 x 10^{6}m^2	1000.0m	500.0m	400.0m	198000m^2	198000m^2	418000m^2	484000m^2	484000m^2