Leaving Certificate Examination

2010

Engineering-Technology Project Design 2010

Higher Level

Examination No.

140026

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Introduction

Design Brief

The global standardisation of containers and container handling technology is one of the important innovations of 20th century freight logistics. Central to this transport environment is the gantry container crane. The gantry container crane generally consists of a supporting gantry structure for a trolley unit. The trolley unit will in turn traverse the working area to locate, raise and lower the container.
Design a model of a gantry container crane to the general specifications outlined:

(a) The model should have a fixed gantry structure;

(b) The trolley unit should:

i) Be incorporated into the fixed gantry structure;

(ii) Have the traverse, raise and lower motions controlled by switches.

Special Note: A model container need not be included in the final solution.
Presentation of the completed model should ensure that:

(a) All main operating features are **clearly visible without dismantling**.

(b) The longest dimension of the device does not exceed **350mm**.

(c) Electric power does not exceed **9 volts**.

Analysis of Brief

From the reading of the brief, it is required to design and build a gantry crane.

The gantry structure must be fixed and must incorporate a trolley.

The trolley in turn must have transverse, raise and lower functions controlled by switches.

These functions will require a minimum of two motors. 9 volts may not be enough to power all efficiently.

No dimension of the model should exceed 350mm therefore design must abide by these restrictions.

Also all operating functions must be clearly visible without dismantling.

Design Process

Research and Development

Q. What is a gantry crane?
A. A gantry crane is a cane with a bridge supported on two or more legs running parallel on fixed rails.

Q. What is a trolley unit?
A. A tram is a rail borne vehicle

Q. What does traverse mean?
A. Traverse is a horizontal movement

Gantry cranes come in a variety of forms from large overhead cranes used in logistics to simple cranes commonly found in workshops.

Each type of gantry crane offers unique design feature to be modified and replicated in the model.
Also safety concerns must be recognised and corrected as best as possible

Aim

The aim of the project is to design and build a gantry structure incorporating a trolley with the transverse, raise and lower functions controlled by switches in accordance with the specifications given in the brief.

Investigation of Solutions

Idea 1.

The first idea is based on a simple four legged gantry crane. The fame will be made of aluminium of iron.
Tapped and bolted together. The trolley will run on two parallel rails and will be driven by a motor driving the back axle by means of gears. (FIG 1.)

Criteria or Selection of Solutions

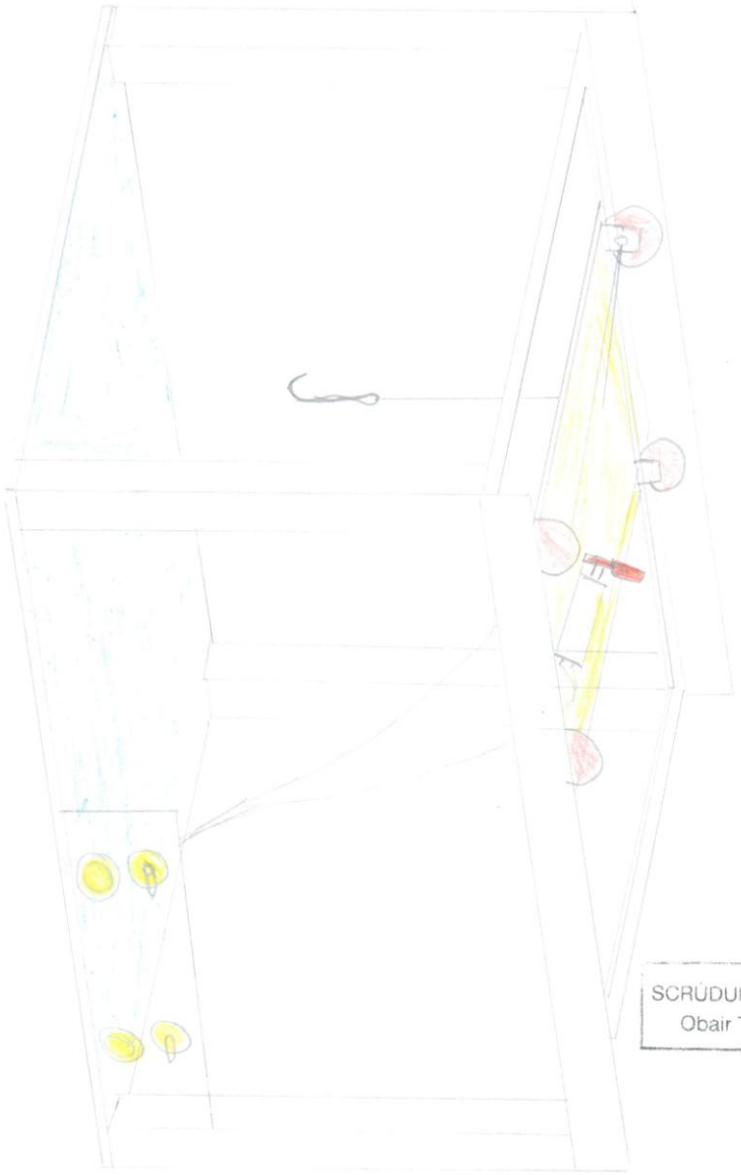
Advantages

- Easy to make
- Not overly time consuming
- Meets specifications of brief

Disadvantages

- Overly simplistic
- Does not use many process'
- Not visually appealing

(Fig 1.)



IDEA 1

SCRÚDUITHE TEASTAIS
Obair Thionscadail

Investigation of Solutions

Idea 2.

This idea is a much more complex structure. The frame itself will be welded which will be a challenge in itself. The trolley will run on two parallel rails and transverse, raise and lower motions will all be controlled by switches. All requirements of the brief are met.

Criteria or Selection of Solutions

Advantages:

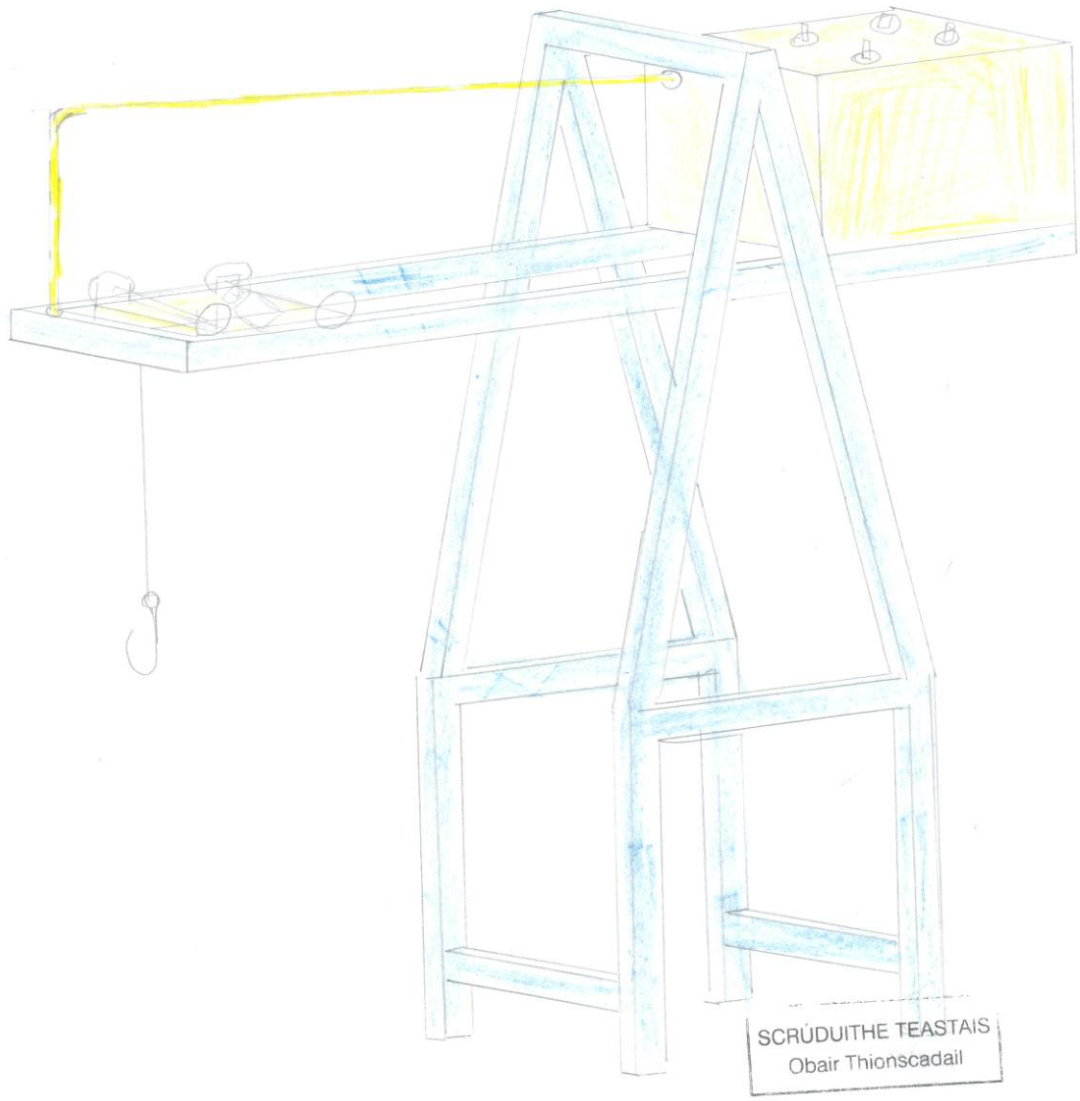
- Visually appealing
- A challenge to make
- Welding would be beneficial to learning

Disadvantages:

- Time consuming
- Heavy
- Difficult to make

(FIG.2)

IDEA 2



Investigation of Solutions

Idea 3.

Simple structure based on common workshop gantry crane.
Trolley runs on single rail.
Design meets all of the briefs requirements.

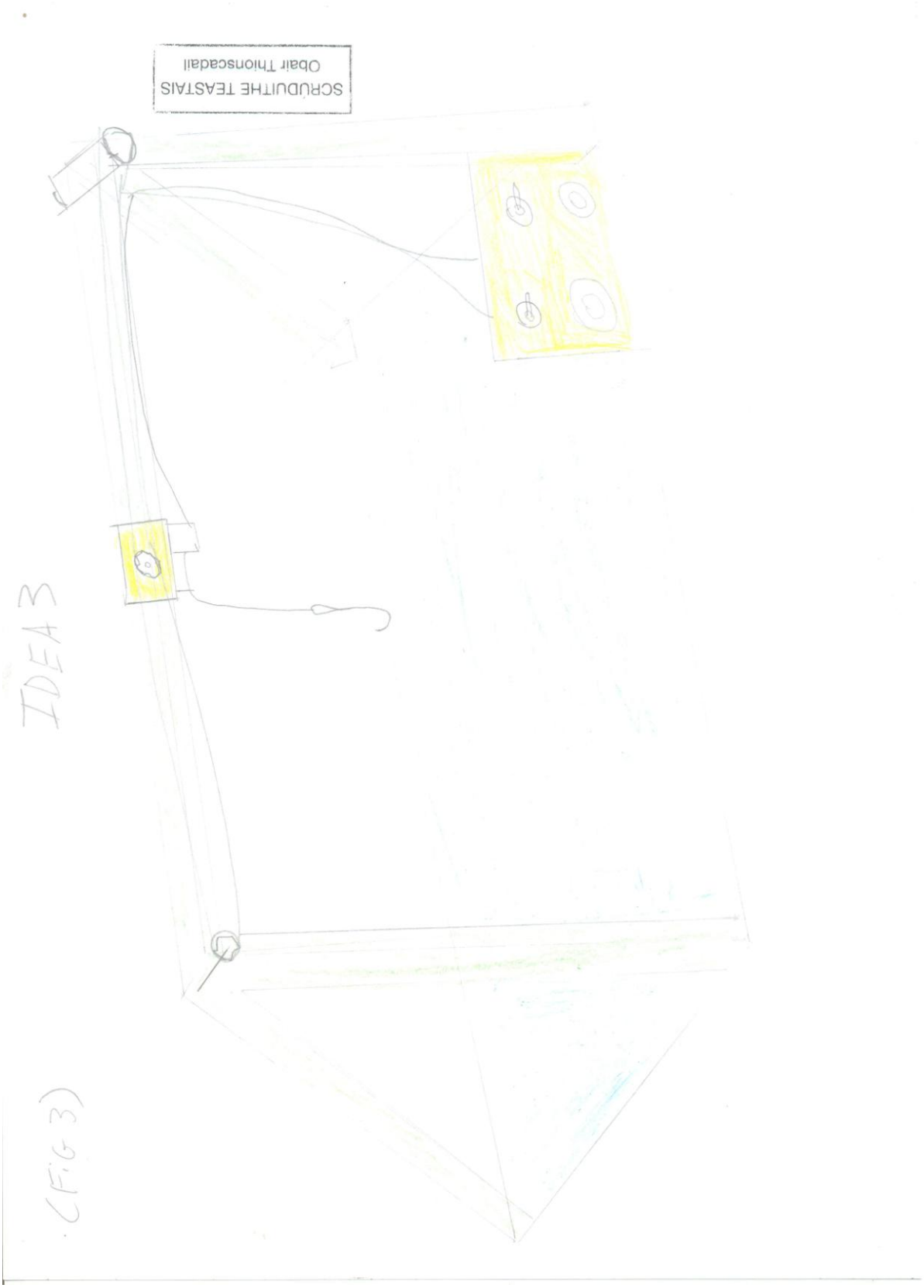
Criteria or Selection of Solutions

Advantages:

- Relatively easy to make
- Not overly time consuming
- Visually appealing

Disadvantages:

- Overly simple
- Too few process' used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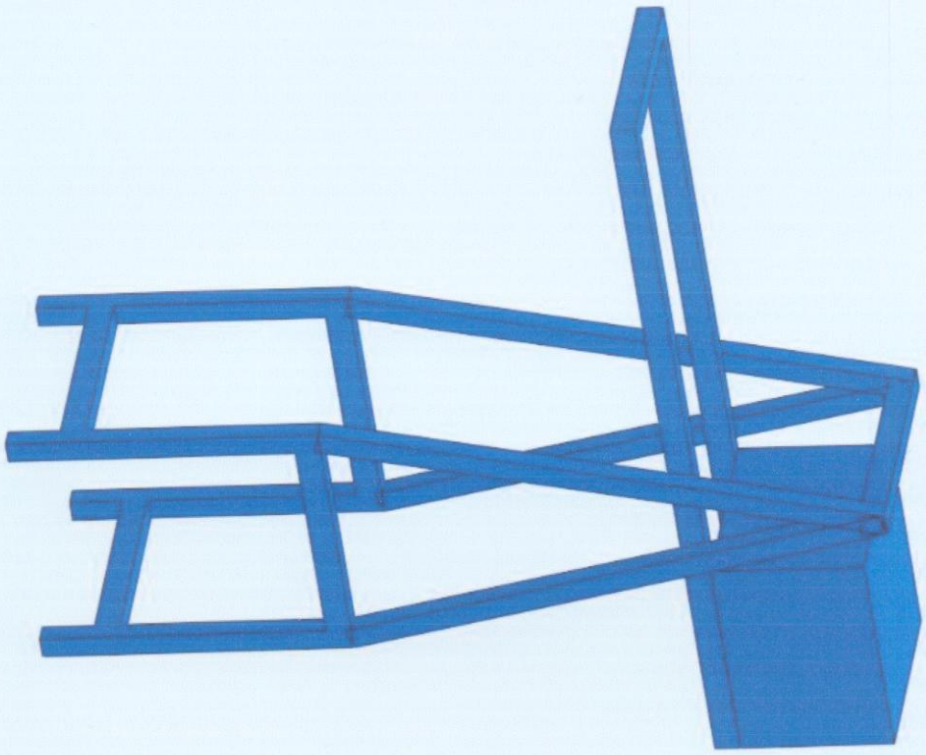
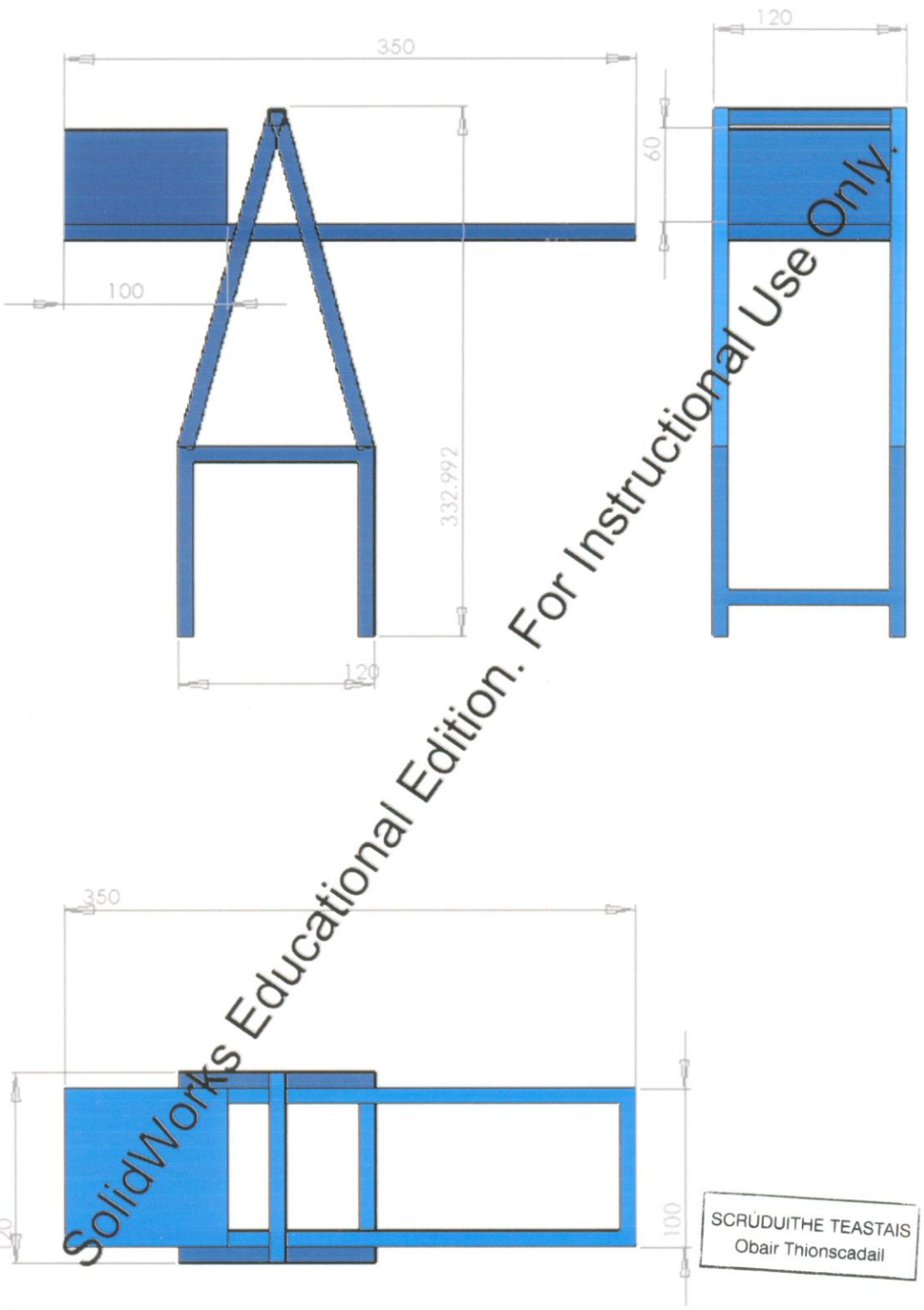
IDEA 3
(FIG 3)

Chosen Solution

The solution chosen to manufacture is idea no. 2. this idea was chosen because it would be a challenge to build. From the designing stage this project stood out well above the rest. It seemed to be the one most capable of fulfilling the requirements of the brief.

SolidWorks render of main structure





Materials used/Cutting List

Quantity	Material	Length/mm	Width	Thickness/mm
4	Mild steel bar	120	10	10
7	Mild steel bar	100	10	10
4	Mild steel bar	220	10	10
2	Mild steel bar	350	10	10
1	Mild steel plate	220	100	3
3	Mild steel plate	60	100	3
2	Mild steel plate	94	10	3
2	Mild steel flat	120	12	3
1	Mild steel flat	80	12	3
1	Mild steel flat	60	12	3
2	Brass bar	100	Diameter 4	Diameter 4
1	Brass bar	60	Diameter 4	Diameter 4
1	Brass bar	40	Diameter 4	Diameter 4
1	perspex	80	80	4

Design Realisation

Problems Encountered

The main problem encountered during the realisation of the brief was with the wiring. The wires impeded the transverse movements of the trolley and would pose safety issues in an actual crane. It was decided that this would be best remedied by mounting a brass bar which would run parallel to the rails and that the wires would be attached to it but at the same time without limiting the flexibility and movement of the wires. This was achieved by enclosing both the brass bar and the wires in cable ties but at the same time leaving them sufficiently loose as to allow movement.

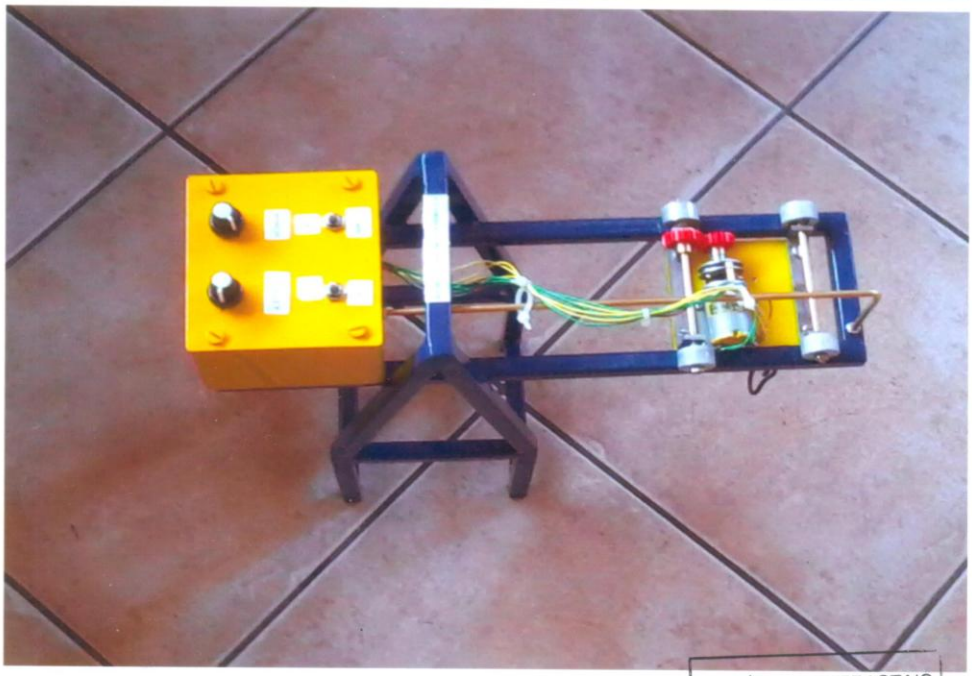
Testing

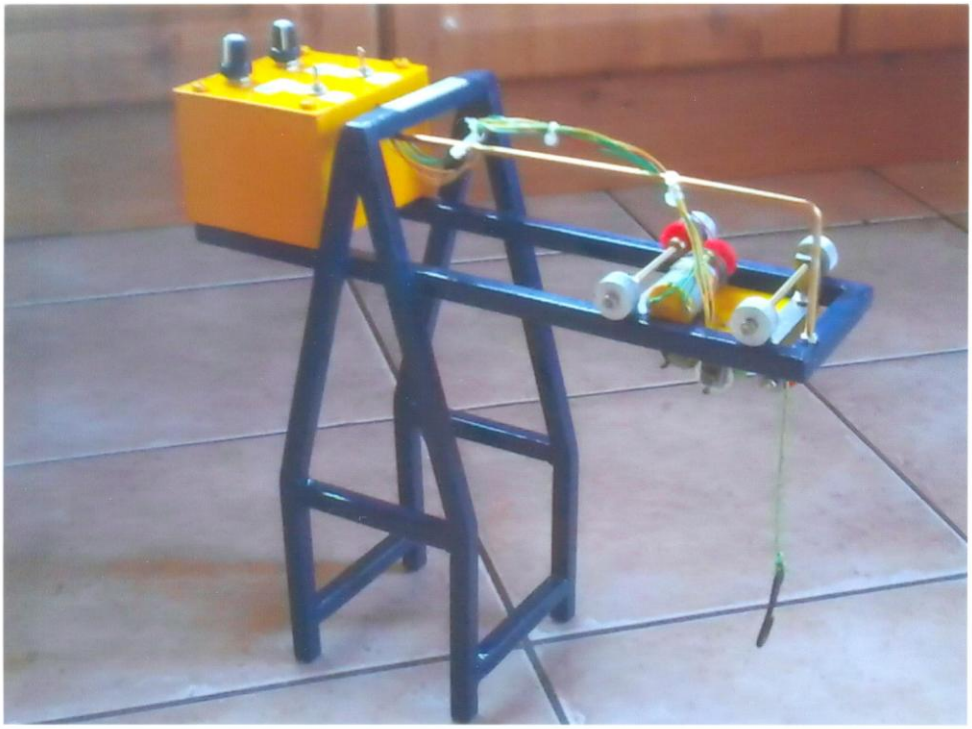
Testing began before long before the manufacturing of the design.
The testing began with a mock up of the intended design made out of simplistic materials and lacking many processes required for the finished product. The mock up was a success and therefore the design was possible.
Throughout the manufacturing processes constant test had to be carried out, to make sure all parts and mechanisms worked such as the raising lowering and transverse movements of the trolley.
For example it was found that a simple motor was unable to provide sufficient torque at low speeds to effectively operate the winch so a geared motor had to be used instead.
A final evaluation was carried out on the finished model to make sure all mechanisms worked and that the product met the requirements of the brief.

Evaluation

Does the model have a fixed gantry structure	yes	
Does the model incorporate a trolley	yes	
Are the raise ,lower and traverse movements of the trolley controlled by switches	yes	
Are all dimensions within 350mm	yes	
Is the model powered by 9 or less volts	yes	
Are all operating features clearly visible without dismantling	yes	

Completed design





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