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Support of Software Projects at Local Industrial Enterprises

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ABSTRACT: In conditions of increasing globalization at modern production facilities, the ability of a modern engineering company to compete in the production of high-tech products is determined by the technological capabilities of the product. These opportunities are represented by quality improvement, timely implementation and low economic costs. Increasing productivity in this direction is an important achievement in the development of modern engineering production.

With the expansion of the product range, the dynamic development of such production involves a constant increase in the need for technological equipment of CAD / CAM / CAE systems. It is characterized by high-quality and resource-intensive production conditions, the development of new products, the development of technological systems and complex production technologies.

KEY WORDS: system, G-code, RDB machine, software, production, design, details, cutting tool, cutting process

I. INTRODUCTION

Read more about the project, details of the maintenance, and the details of the technology and functional details of the role of the manufacturer in the production of machine tools. We are working on the problems of machine-to-machine forecasting. CAD / CAM / CAE.

The role and importance of CAD / CAM / CAE systems in the design and manufacture of engineering products indicates that the design department at the manufacturing enterprise should take into account financial resources in the production and production of marketable products. This distribution has two directions: expensive and profitable. In the first area, the main goal of a manufacturing enterprise may be the desire to manufacture and minimize costs associated with the production of new products on the market.

In the second direction, the main task of the manufacturer is to expand the range of demand for products. The distribution of financial resources of manufacturing enterprises under the influence of information systems related to the capabilities of CAD / CAM / CAE systems is new:

Reducing the cost of technology and parts from part 1;

Reducing the costs associated with the need to make changes to the project at the next stage of development 2 (planned development);

3) Accelerate the technological preparation of production (quick start of production);

Increasing customer satisfaction with the time and cost of the project;

5 Respond quickly to market needs;

6-increase customer satisfaction with product quality and performance;

Flexibility of developing new 7 markets;

The ability to expand the characteristics of the goods after the 8th sale (replacement, maintenance, etc.).

The ability to use the knowledge of the 9th computer in new projects.

Dissemination of information technology projects for the management of financial resources of a manufacturing enterprise.

Engineering processes include automation methods and design selection, knowledge of production planning and operational management, the role of engineering in the republic and the results of socio-economic reforms.

Modeling is a very simple solution when removing some complex surfaces.

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Development of control programs in NX CAM is carried out in several stages. The operation sequence is shown in fig. 1.2. Not all steps are required.

Work begins with the selection of the processing environment (initialization). Different types of processing use different templates for initialization. At this stage, those objects are created that are necessary for this type of processing.

The next step is Geometry Analysis. The stage is necessary if the technologist of the model did not create, but received it from the designer or a third-party customer. At this stage, the overall dimensions of the part, the dimensions of the elements (groove width, hole diameter, etc.), the radius of rounding of the model elements, the presence and magnitude of the slopes (for equipment) are analyzed.

Preparing the model for processing is sometimes necessary, at this stage you can remove the elements that will be obtained in other operations (for example, by EDM), add slopes, allowances, modify model elements taking into account the tolerance dimensions, etc. In fact, these are CAD operations for CAM tasks, they will also be discussed later.

The correct approach is not to modify the design model itself, but its associative copy.

An important step is creating or editing parent groups. This is a distinctive feature of NX CAM; objects defined in parent groups are inherited by the operations associated with them. This approach allows you to manage immediately all operations that use a specific parent group by modifying the objects of this group. Parent groups are defined for 4 categories: Program, Tool, Geometry, Method. This is discussed in detail in the next section.

Next is the stage of creating or editing processing operations. Operations are of different types and use different parent groups. We will pay attention to this when considering specific operations. Operations with specific parameters can be saved in the project without generating them. This is useful if the process of generating operations takes a considerable time. The generation of trajectories is taken out in a separate stage, and it can be carried out immediately for a group of operations. Checking the tool paths is necessary in order to identify possible problems, such as notches or collisions of the tool with the snap. NX CAM has several tools for checking trajectories, including simulation of the machine, carried out in the codes of the control program.

Prior to the postprocessing stage, the paths are independent of a particular machine. In order for the trajectory to be worked out by the machine, it must be Post-processed (or converted to the format of a specific machine). It is at this stage that a control program (UE) is obtained, and one UE can include several trajectories created by various operations. However, the postprocessor is incorrectly regarded as a simple converter, it can perform additional checks, calculations, can analyze some conditions and, depending on this, modify the displayed information.

Modern production relies heavily on the use of CNC machines. The machines themselves are becoming more complex, becoming more intelligent. However, their effective operation requires effective management. Increased competition and market demand for complex products make enterprises think about the comprehensive automation of production preparation and production itself. In this setting, the stage of development of control programs is no longer perceived as an autonomous task, but should be associated with other stages of design and technological preparation of production.

Reducing serialization, as well as increasing the variability of output, leads to the need for flexible changes in control programs in accordance with the changes. Developing a new management program from scratch is the most inefficient way. It is necessary to make maximum use of previous developments.

The CAM-system is required to have tools for checking programs for notches and collisions. This allows you to significantly reduce the process of introducing UP on the machine, as the machine should be used to the maximum extent for production. The setup time, and especially the downtime as a result of a breakdown, is expensive for the enterprise. It is necessary to check control programs outside the machine based on G- / M-codes taking into account the entire technological system (Machine-Tool-Tool-Detail).

The advent of modern turning and milling multifunctional machines significantly changes the production technology itself, the concentration of operations increases, and the number of plants decreases significantly. The programming of such machines should, to the maximum extent, take into account the current state of the workpiece, including when transferring between turning and milling operations. The presence of several working bodies (for example, a milling spindle and a turret) allows you to perform processing in parallel for maximum productivity. Such work even more requires verification of the control unit in the context of the entire machine, including technological equipment.

The NX software package has many new features and improvements that significantly increase product development productivity. Improvements to integrated CAD applications in NX include quick design tools, such as simplified sketching, transformation of free-form models using synchronous technology, and new documentation tools that significantly improve the quality of 2D design.

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New rapid design tools accelerate the creation and placement of 2D profiles, automatically imposing restrictions and identifying the intent of the creator of the model. As a result, the time to create a model is reduced to 50%.

The integration of revolutionary synchronous technology with modeling of free-form bodies in NX transforms the process of working with models with complex geometry, including those imported from other CAD systems. Users can create a simple prismatic or analytically defined form, and using appropriate tools, complex organic models.

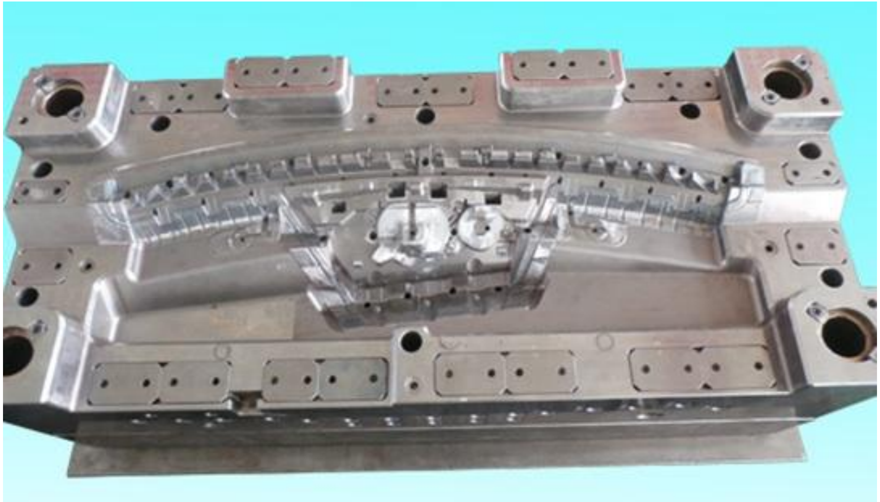

Fig. 1. Development of control programs in NX CAM.

II. THEORETIC INFORMATIONSYSTEM CAM

CAM is a leading 3D relief design software. CAM translates ideas into finished products much faster than possible using conventional methods.

CAM Express is an entry-level system and therefore requires minimal knowledge of modeling and processing from the user, it is ideal for inexperienced users. The program toolkit contains functionality that allows you to implement a project starting with a sketch, and ending with the manufacture of the product. CAM Express is designed for engraving, milling various materials, cutting from sheet material and solving many other problems.

In the Delcam CAM product line, the CAM Insignia version ranks between the basic version of CAM Express and the full-featured version of CAM Pro. CAM Insignia contains a complete set of tools for working with vectors and bitmap graphics, as well as for creating and editing 3D reliefs. The system allows using the obtained model to create a set of tool paths for various CNC equipment. It can be either simple desktop engraving machines or milling machining centers. In addition, the program allows you to create control programs for laser processing.

CAM Pro is a software package for spatial modeling / machining, which allows you to automatically generate spatial models from a flat drawing and get products from them on CNC machines. CAM Pro offers a powerful, easy-to-use set of modeling tools that gives the designer the freedom to create complex spatial reliefs.

CAM JewelSmith is a technology-design package designed to replace the engraver's manual labor with machine work and, in some cases, eliminate it altogether. This system allows you to quickly and easily create three-dimensional models from two-dimensional images presented in standard formats of graphic packages: raster - BMP, TIF, PCX, GIF, JPEG and vector DXF, AI, EPS, WMF, as well as native Delkovsky - PIC. CAM JewelSmith contains tools for modeling complex shapes and combining saved reliefs, generating toolpaths for roughing and finishing engraving strategies, and preparing data for rapid prototyping machines and 3D printers. Easy and intuitive Russified Windows-interface, speed of study and a wide range of features allow it to take a solid place in the instrumental baggage of the designer and technologist.

Trajectory for GUS

The tool path for high-speed milling must satisfy a number of requirements, most of which are quite obvious:

the tool must not hammer the part;

the cutting load on the tool should be within its permissible limits;

the tool path should not make sharp protrusions (peaks) exceeding a certain limit;

sudden changes in material removal rate must be avoided;

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speeds and accelerations must be within the permissible limits for the machine;

the on / off cutting direction should be supported;

sudden changes in cutting direction should be avoided;

idling should be minimized;

the travel time of the entire trajectory should be minimized.

However, with respect to a particular part, it is very difficult to create a tool path that meets all of these requirements. Usually, all these limitations cannot be taken into account when finishing a real part of complex shape. The best thing to do in this situation is to take into account the most significant limitations and neglect the less significant ones. Some of these restrictions are indeed crucial, they are listed above in order of priority.

Finishing poses a particular challenge for the HLW, as the shape of the part is a limitation that cannot be circumvented, and imperfections in cutting conditions often appear in visible marks on the finished surface. Of course, roughness can be polished, but this undermines confidence in the GUS. Roughing or semi-finishing is easier to optimize, since the CAM operator can correct the shape of the part after the operation and remove the marked features during finishing.

To the beginning To the beginning

Program scope

Good programs for high-speed processing are executed on the machine very quickly, but their creation requires much more time and effort. In the manufacture of molds and dies, where the part is manufactured in a single copy, delays in waiting for the program are permissible. Attempts by CAM-operators to speed up the creation of programs can lead to angular cutting, as a result of which the program becomes less efficient. The optimal balance will be achieved when CAM-operators can also support machines with reduced speed.

Of course, this is not an ideal strategy. In order to get the best result from GUS, it is very important to ensure an adequate CAM volume so that the machine is fully loaded with high-quality programs:

Choose CAM software that has the capabilities you need for high-speed processing. This will reduce the burden on operators who need to optimize their programs;

Choose CAM software that quickly calculates toolpaths with no cuts. Batch computing allows you to calculate complex programs at night;

Use powerful computers and update them regularly. Make sure that the computer has enough RAM;

make sure that you have enough CAM-operators and they have the necessary experience and skills;

make sure that the operators are properly trained to create GUS programs. Training operators to create workplace programs is a good way to use existing knowledge. Delcam regularly hosts the HSM Master Classes in collaboration with H.R. Pearce and Mitsubishi.

To the beginning To the beginning

Processing sequence planning

For all parts, except for the simplest, the GUS is divided into several steps. Choosing the right sequence of steps is the most important stage of GUS programming, and this is where experience is most valuable. The vast majority of user problems that we saw in Delcam were due to improper use of the processing strategy, and not due to errors in the strategy itself. The level of automation in systems such as PowerMILL is constantly growing, but user attentiveness and caution cannot be replaced with anything.

It is useless to describe the entire planning process here, but here are some simple recommendations:

First of all, think about the material that you need to remove, and not about the finished finish form of the part that you are trying to do (Fig. 2 shows how this can help in understanding what is happening);

Take as few steps as possible;

Prefer continuous cutting strategies (for example, offset trajectories are usually better than raster);

Avoid immersion in material if possible. Use any convenient opportunity to approach from the side of the workpiece;

Avoid overlapping with various finishing treatments at critical parts of the part, as visible marks will remain where the treatments are applied.

Try to use one tool when finishing critical sections of the part, since errors in the installation of the tool can lead to visible defects on the surface;

Leave the cutter as short as possible, as the long cutter wears out faster. If necessary, reorient the part so that hard-to-reach parts

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III. RECOMMENDATIONS

The created geometric bodies in NX are divided into surfaces and solids. One of the subspecies of a solid is a sheet metal part model, for the creation of which several specialized NX applications are proposed. Solid modeling is the creation of a closed geometric volume that describes the geometry of the part. For this, primitives obtained by stretching and rotating flat contours, structural elements and logical operations of combining bodies are used. There is no explicitly expressed solid-state modeling module in NX, since tools from different applications are used for this. In particular, solids can be obtained by giving the thickness of the surface to the shape created in the Studio application, or by filling a closed loop from the surfaces.

The main goal of modeling solids is to create an accurate geometric representation of the designed part, which will be the basis for the production of documentation, calculations and writing CNC programs. From the point of view of the system, the geometric representation is the result of a connected sequence of operations that make up the model building tree. The user's job is to add operations to the construction tree that create certain structural elements or modify the geometry. This is true for a classic modeling case with a build history. NX also supports modeling without a build history, which will be discussed in a separate chapter. This chapter will provide an overview of the basic tools for creating solid models in modeling with a history of construction.

To create models, you can use typical structural elements or create bodies based on two-dimensional contours, as well as combine these two methods. Sketches are the basis for all bodies obtained by rotation or pulling along a path.

Progressive stamping

Progressive stamping is a metal forming process widely used to produce parts for various industries, such as automotive, electronics and household appliances. Progressive stamping consists of several separate workstations, each of which performs one or more different operations on the part. A part is transferred from station to station along the reserve strip and in the last operation is cut down from the strip.

Progressive stamping-from steel strips to finished parts

With progressive stamping, a steel strip is formed into a finished part in a few operations.

The decision to make a part in a progressive or transfer head depends on the size, complexity and volume of production. Progressive stamping is used to manufacture a large number of parts and maintain costs at the lowest possible level. The highest requirements for precision and durability must be met.

Due to the complexity of progressive dies, it is important to consider all factors that contribute to achieving the desired level of part quality, including the position of the workpiece, pilots, workpiece boundaries and the deformation of the stretch tape.

Pilots play an important role in progressive stamping-they fix the strip in the proper position and retain control over it. In addition, they are necessary for precise positioning of the sheet during tool closing and drawing operations in the transfer matrices. Other factors to consider are the time and interaction of the holders, pillows, and upper and lower tools. The advantages of progressive stamping are increased productivity and a significant reduction in costs in large-scale production.

IV. METHODOLOGY

Metalwork modeling

When modeling metal molding, sheet metal molding is modeled on a computer using special software. Simulation can detect errors and problems, such as wrinkles or cracks in parts, on a computer at an early stage of formation. Thus, there is no need to create real tools to run practical tests. Molding imitation has become popular in the automotive industry as it is used to design and optimize every sheet metal part.

To illustrate the metal forming process, there must be a model of the real process. This is calculated in software using the finite element method based on implicit or explicit increments. Model parameters should describe the real process as accurately as possible so that the simulation results are realistic.

Metal forming simulation-modeling the entire sheet metal processing chain

Simulation of metal molding allows you to quickly and accurately simulate the entire molding process, including drawing and secondary operations, as well as elastic recovery. In this way, the part can be developed fully and efficiently.

Typical parameters for molding modeling are, for example, part and tool geometry, material properties, pressing forces, and friction. Simulation calculates stresses and strains during the molding process. In addition, modeling allows you to recognize errors and problems (for example, wrinkles or splitting), as well as results (for example, strength and thinning of the material). Even the elastic recoil, the elastic behavior of the material after molding, can be predicted in

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advance. Molding modeling also provides valuable information about the effect of process changes on stamping reliability.

Molding modeling is used throughout the entire sheet metal forming process chain. Modeling allows the part designer to evaluate the formability of a sheet metal part already at the design stage, which leads to the creation of a part that is easy to manufacture. The process engineer can already evaluate the process at the planning stage and optimize various alternatives using simulation, which subsequently can reduce the fine tuning of the forming tool. Finally, with regard to fine tuning the forming tool, modeling can provide useful information on how to tune an existing, not yet fully functioning tool. You can also see how the process parameters should be adjusted to guarantee optimal drawing results.

Strength

Reliability is an important topic in the sheet metal forming industry. Traditionally, companies have focused on the reliability of stamping at the production stage through their manufacturing and quality departments. Today, modern modeling software allows companies to also solve the problems of stamping stability in the early stages of product design and tooling. In other words, companies can now design better product designs and better tool designs for a reliable stamping process.

With reliable analysis, the stability of the deep drawing process is analyzed under predetermined process conditions. In everyday production, parts can be produced smoothly in one day, and problems arise the next day, even if the production conditions do not seem to have changed at all. This is due to noise and changes in the molding process

In real production conditions, there are important, but inevitable and uncontrolled changes to the drawing parameters. These variations can be divided into two classes:

Noise in the parameters of the molding process, such as, for example, the force limiting the pulling of the roller, bevel radii due to tool wear, pressure changes in the workpiece holder due to the pressing state, lubrication fluctuations, etc.

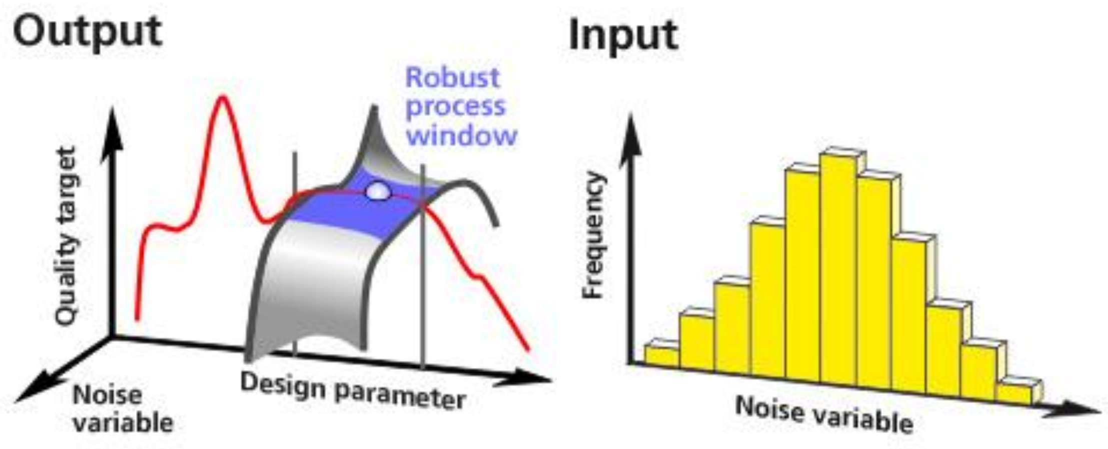
Noise in material properties, such as, for example, yield strength, tensile strength and r values, which vary from coil to coil and from supplier to supplier

Reliable analysis is performed to analyze the effect of noise variables on the formation process. The user defines the change for each noise variable in the form of an average value and the corresponding standard deviation. Based on this change, multiple simulations are carried out. All simulations available are then analyzed using an analysis identical to the sensitivity analysis. However, the analysis is currently based on a change in noise variables, and not on project parameters. Thus, a quality function is calculated, which depends on the noise variables. With a reliable analysis, you can check whether the molding process provides stable results under the influence of total noise of various parameters.

Noise variables for reliable analysis.

Input diagram of noise variables for reliable analysis.

Reliable process window in robust analysis.



Reliable analysis allows you to determine a stable and capable process.

If the influence and sensitivity of the noise variables is known, the molding process can be designed accordingly to:

Noise does not affect the desired quality of the result.

Nominal marriages are minimized while production efficiency is improved.

Tolerance limits for material quality control can be determined.

The result is used to predict the stability and ability of molding processes depending on the selected noise variables. Reliable analysis allows the user to determine a reliable process window that takes into account the best formation conditions taking into account noise variables.

Solving the stamping stability problem is important because potential stamping problems can be solved at an earlier stage in the vehicle development cycle, which saves more time and resources. This means faster entry into the market for new car models with obvious benefits.

V. EXPERIMENTAL RESULTS

A joint venture established in the Republic of Uzbekistan, since 2012, uses progressive molds using CAD / CAM / CAE systems managed by UZ-HANWOO ENGINEERING LLC. Advanced technological presses with advanced technology The use of advanced technologies in production technology requires the production of molds, improved molds, improved quality of parts, extended shelf life and extended working surface life. UZ-HANWOO ENGINEERING LLC uses mold processing technology. The quality of the printing plates determines the accuracy of the parts. Mold preparation is a complex process. Therefore, the working part of the mold is in great demand. Mold preparation is carried out in several stages. First of all, mold paper is made. After stamping, the required mold part is removed and heat treatment is applied to the work surface. Heat treatment also requires a lot of attention.

Progressive molds require the formation of consistent surfaces. This process also requires a lot of hard work. The geometric dimensions of the parts are taken into account. SAM systems help us with the project. SAM systems create a virtual environment that helps us create molds and create complex notebook surfaces. SAM systems were developed by NX to extend the life of progressive molds manufactured by the UZ-HANWOO ENGINEERING JV to predict errors in production processes. Defects in progressive printing forms are resolved and resolved in a virtual environment.

We can understand the appearance of the mold as an example. UZ-HANWOO ENGINEERING has led to significant labor savings. The development stages of CAM systems in the region are rapidly developing.

Fig. 2. Development of mold parts for control programs in NX CAM.

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N0010 G40 G17 G90 G70	N0700 X.4582
N0020 G91 G28 Z0.0	N0710 X.7104
N0030 T01 M06	N0720 X.7183
N0040 T00	N0730 Z2.0327
N0050 G00 G90 Y0.0 Z4.277 S678 M03	N0740 G01 X.671 F24.8
N0060 G43 X1.1787 H00	N0750 X.6656 Z1.9291 F17.7
N0070 Z3.8421	N0760 X.671 F29.8
N0080 X1.0512	N0770 G00 Z1.9625
N0090 G01 X1.0039 F7.8 M08	N0780 X.7044
N0100 X-.0472 F5.4	N0790 Z4.277
N0110 G00 X-.0945	N0800 X1.1787
N0120 Z3.9602	N0810 G91 G28 Z0.0
N0130 X1.0512	N0820 T00 M06
N0140 Z3.7472	N0830 T01
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N0170 G00 X-.0945	N0860 Z2.7704
N0180 Z3.8653	N0870 X.5508
N0190 X1.0512	N0880 G01 X.5429 F40.5
N0200 Z3.6523	N0890 X.3483 F27.4
N0210 G01 X1.0039 F7.8	N0900 G04 P.026
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N0320 X.8858 F25.4	N1000 G01 X.5429 F40.5
N0330 G00 Z1.9625	N1010 X.3483 F45.6
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N0350 Z3.8177	N1030 X.35
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N0380 Z1.9291 F29.5	N1060 X.4326
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